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FATAL ELECTRIC SHOCKS.

WITHIN a week we have read of three sad and fatal accidents arising mainly from carelessness in handling electrical apparatus. In one case an employé of the Thomson-Houston Company at Chicago was the victim; two men in Spain lost their lives simultaneously in another. In both instances the men had been warned of the serious consequences which might result from carelessness, but either foolishly or heedlessly disregarded the cautions given them.

At Chicago O. G. Clark was at work testing arc lamps, which were running from a 50-light dynamo. The machine was loaded with 44 or 46 lamps, the number varying slightly. He received the shock, which caused his death, in this way: He held a part of the lamp which he was testing in his left hand. He reached around the lamp with the intention of throwing the switch off by means of a stick which he held in his right hand. As he did so he raised the lamp from the hanging wire and short circuited the current through himself. The current passed between the left hand and the elbow of his right arm. He groaned and fell backward upon the floor. He breathed heavily for a few seconds, and then respiration ceased. The heart continued to beat for about 10 minutes. Two physicians were immediately summoned, and for three hours endeavoured to resuscitate the unfortunate man but without success. The circuit was a short one which had been put up for testing purposes only. Only the lights which were being tested were on the circuit.

This accident occurred, be it remembered, in the testing shop of an electric light company, where a correct knowledge of the consequences of establishing a short circuit by means of the body might be supposed to prevail. Indeed, according to the evidence given at the inquest, Clark, who was an ambitious and somewhat venturesome young man, had been specially warned not to touch the lamps with both hands. The electrical engineer in charge of the testing department asserted that he was aware of no means which could be taken to lessen the risk of accidents of this character in the shop beyond those already observed. The installation was regarded as being in a transitional stage, and no certificate had been obtained from the city inspector, who stated that it complied with the law and that no certificate was required. In the face of this statement, a copy of the city ordinances relating to electric lighting was handed to the jury, and after studying it, that enlightened body returned a verdict that Clark came to his death from an electric shock, adding that they believed the company was greatly to blame in not complying with the law. Wherein the company failed to comply with the law was not even so much as suggested. Every reasonable precaution to ensure safety appeared to have been observed, and most positive injunctions were laid upon the men, upon this man in particular, not to attempt to adjust the lamps, but to report any irregularity. If after this a man disregards the advice, even the commands, of his superior, it is scarcely just to blame the electric light company. It is asking too much to expect employers to make casualties impossible to careless workpeople, and we cannot help thinking that the verdict, or rider, of the Chicago jury was a little harsh, and that it was not justified by the facts as stated.

The accident in Spain was at the Valladolid electric lighting station. A carpenter who was doing some work in the place, although he had been told not to touch any apparatus, took hold with both hands of some high tension wires, and the electrical attendant, seeing that the poor fellow could not free himself, went to his rescue and tried to pull him off. Both men received a shock, and were killed. The local correspondent of the journal from which we extract this information, as a kind of explanation of this accident, says that the applications of electricity are progressing in Spain very much faster than competent men can be trained, and that there is no organisation, public or private, in which the necessary instructions for handling electrical apparatus are systematically given.

THE PACIFIC CABLE.

OUR readers will find elsewhere a notice of yet another total interruption of the cables that at present form our only means of electrical connection with the great colonies of Australia, New Zealand, and Tasmania. This is the third time that such an event has occurred in the last four months. These cables have been interrupted 20 days out of 114, and at the time we write are still broken down. This alone, in face of a statement made a fortnight ago by the chairman of the Eastern Extension, Australasian, and China Telegraph Company that the receipts for the half year show an increase of over £20,000, appears sufficient reason for the dissatisfaction felt with the present service, both as regards the tariff and security of communication.

Early last year a proposal was laid before the Colonial Conference by the above company to lower the present heavy rates to 4s. per word, and that if the colonies would guarantee three-quarters of the then existing traffic, the company would accept the risk of losing the remaining quarter. This proposal affords either a good guide as to the extent to which the company might be expected to reduce its rates without undue loss; or it may be taken as an indication of the opinion entertained by the directors that a lower tariff would so much increase the traffic as to render the guarantee required a mere nominal affair.

It is, however, obvious that, if by offering a guarantee,

such as above indicated, the Colonies can secure a new cable laid over a new route, it would be absurd on their part to join in such an undertaking with regard to the very cables of which they complain, and it may be easily understood that these Colonies which already pay an annual subsidy of £36,000 for the maintenance of telegraphic communication, should object to hamper themselves further, while they have a fair prospect of remedying the present intermittent service.

Another proposal was laid before the conference, at which all the British Colonies were represented, advocating the establishment of a telegraph line between the Australian Colonies and Canada, touching only on British territory. This proposition was introduced by the representative of Canada, Mr. Sandford Fleming, and was strongly supported, a resolution being unanimously passed by the Colonial representatives to the effect that "the connection of Canada with Australasia by direct submarine telegraph across the Pacific, is a project of high importance to the Empire, and every doubt as to its practicability should without delay be set at rest by a thorough and exhaustive survey."

The amount of attention which H.M. Government are paying to the above resolution, may be taken as an indication of the slight value they attach to the deliberate opinion expressed by the representatives of the Colonies interested; it cannot, however, be taken as representing the value which such a cable would be to the Empire.

We have noticed elsewhere a vague criticism in which this scheme was mentioned as "one of sentiment," but the grounds of complaint against the present state of affairs are certainly sufficient to show that the matter has become one of paramount importance.

There has been a good deal of loose talk as to the difficulties which such a line laid across the Pacific would have to encounter; the route has been described as crossing "enormous and unsurveyed depths terminating in coral reefs." This criticism may sound well, but it is about as correct as the other objections advanced against this route. To state facts, there are more than 250 soundings in depths of over 1,000 fathoms which bear directly on this route, and although the depth in some cases reaches about 3,000 fathoms, there is nothing to show that the bottom is an exceptional one. As to the lines "terminating in coral reefs," experience has sufficiently demonstrated that no insuperable difficulty is presented in the landing of cables under such conditions when sufficient care is taken.

We expect to know more on this subject when the survey now being made by H.M.S. *Egeria* is completed. Opponents to the scheme have objected that the depth is great, but those with technical knowledge are well aware that a cable laid in such great depths is less liable to damage and disturbance than where it is more subject to the action of currents, &c. The cable connecting Brazil with Portugal, which has given less trouble than the majority of submarine cables, lies in places at depths of only 200 or 300 fathoms less than the deepest water in which the proposed Pacific cable would be laid. One of the main advantages in such a deep-water cable is, that it would be free from attempts at interruption, which might be made by a hostile power, whereas the existing lines pass not only through foreign territory, but are also laid at places in such shallow water that they can be as easily damaged by an enemy as they at present seem to be by natural causes.

MONS. P. R. F. D'HUMY does not yet intend to hide his light under a bushel, for in the *Lady's Pictorial* of September 29th we have a portrait of the famous water battery rejuvenator. In a little memoir of Mons. D'Humy's career we notice the following, which we think will be startling news to telegraph engineers. "In 1862 M. D'Humy introduced the first method of telegraphic printing into England, which at that period caused a great sensation, and we owe the telegraphic tape with printed messages to his ingenuity." What, we wonder, will next be claimed for this erratic being who, by means of his cabinet battery has, according to our illustrious—we mean illustrated—contemporary brought the electric light within the reach of all. What food there is for reflection in the simple expression "within the reach of all," yet how few ever succeed in grasping that which is so near and yet so far!

AGAIN, how thin is the line of demarcation between the sublime and the ridiculous. On the very next page to that on which Mons. D'Humy poses in an attitude at once characterised by ease and grace, we find the Diva, the unrivalled queen of song, Adelina Patti. After all, is it not worth while being eccentric or, as our American friends would say, "a crank," to appear in such company? At the same time, the proprietors of the *Lady's Pictorial* should exercise a little more discretion in the selection of the subjects which they think fit to immortalise in their pages, and acquaint themselves with the antecedents of the eminent personages who are on the eve of revolutionising—this is the term generally used—the world. We may add for the benefit of those of our readers who have artistic tastes that the reproduction of the eminent Frenchman looks suspiciously like a monochrome in water.

THE advantages to the electrical trade and the electrical engineering profession of such an organisation as the new section of the London Chamber of Commerce, are early apparent. The remarks made with the mere object of filling up time at Monday's meeting, are an earnest of the valuable character future discussions are likely to assume. There were slight differences of opinion as to the precise functions of the section, or of the Chamber as a whole, but these differences are capable of being brought into harmony, and, now that a thoroughly representative working committee has been elected, there is every likelihood of the Electrical and Allied Trades Section immediately entering upon a busy and an extremely useful career. It is no part of our desire to make any attempt to define the powers and functions of the new body, for we are convinced that it will speedily discover and decide for itself what are the bounds within which it will be wise for it to expend its energies. It enters upon its vocations at a very suitable moment, just as new vistas are opening out to the electrical view, new fields of action presenting themselves, bestrewn with new questions and new

difficulties requiring solution, and it must obviously become an important factor in the future arrangements of electrical work of various kinds. Quite a list of subjects of a more or less pressing nature was made up by the contributions of different speakers at the meeting on Monday, and the early discussion of many of those subjects cannot fail to be of great benefit all round. Speaking generally, it must be admitted that the Electrical Section has made a promising start, and we sincerely hope that it will justify the faith that is in it.

We have been favoured with a summary of a theory of the relations between light, heat, sound and electricity from the pen of Mr. John Palmer, who is already known to our readers as the designer of impossible dynamos. We really wish our correspondent would favour some of our contemporaries with his effusions. Mr. Palmer states amongst other highly interesting items of information that "the separate molecules of a body may be vibrating, and at the same time *groups* of the same molecules may be in another rate of vibration, thus producing in the same body, at the same time, several different phenomena." If the gentleman who has hitherto tried hard, but unsuccessfully, to dodge the magnetic lines of force could but see us now he would behold a living illustration of his theory, for there are several different phenomena pervading in a marked degree our editorial body much to the dismay of those around us. But seriously speaking, Mr. Palmer, what sins have we committed that we should have to endure these periodical inflictions?

WE are indebted to Professor Elihu Thomson and Mr. Wightmann for a highly interesting and most readable paper on the phenomena of magnetic propagation. We believe that articles of this nature, filled as they are with simple and easily understood experiments, are far more calculated to give the electrical engineer a clear understanding of the laws of magnetism than those which teem with mathematics. If investigators who are more than liberally gifted with a talent for mathematical reasoning would make it a means to an end and give the results of their researches in a manner identical with that of Professor Thomson and his fellow labourer, we believe that the practical application of scientific laws would be much more rapid than is at present the case. We trust that these gentlemen will continue their labours in the same manner and adopt the same simple method of expressing their meaning to the electrical fraternity.

THERE has just been issued a new list of the members of "The Institution of Civil Engineers," an association which, in point of numbers, is probably the largest of any voluntary society, the roll of its members, associate members, associates, and students aggregating 5,529. In our last issue we touched at some length upon the points of connection existing between the Institution and the interests of electrical engineers.

A FINANCIAL contemporary recalls attention to the proposed amalgamation of the telephone companies, and says it is assured by "private advices" that some advance to an understanding between the various companies has been made, and that the negotiations will shortly assume a more definite and public form. These remarks would seem to point to the inference that the negotiations are in a more advanced stage than we are inclined to believe, from their nature, they can yet have reached. Those who have given consideration to the matter must have perceived how multifarious and delicate are the questions which must arise, and how difficult must be the task of adjusting the necessarily variant estimates of each company's position until a common basis is arrived at from which to commence the more definite consideration of the objects of the negotiations. The amalgamation may or may not come; but it is almost certain that the negotiations will not "shortly assume a more . . . . public form." If they prove successful, they will doubtless be made public in course of time; if they do not result in an understanding and an agreement to federate, the public is not at all likely to be troubled with details, in which, seeing their *nil* effect, it can scarcely be expected to interest itself.

LAST week we had something to say about the complaints in a Glasgow paper of a "telephone girl." These complaints, put briefly, were of hard work, long hours of close application, and little pay. Our remarks were based upon the correspondence which had at that time appeared in the *Glasgow Daily Mail*, and we were careful not to accept the statements made as necessarily correct. From information which has since reached us, taken in conjunction with more recent letters, we have come to the conclusion that the complaints were in no wise justified, and that many of the assertions made were of an entirely mendacious character. For instance, one strong point urged by "One of Them" was the inadequacy of the payment made for the trying work performed, 6s. per week being stated to be the actual weekly salary of a switch girl. The truth is—and we have had excellent means of arriving at the truth of the matter—that 6s. is the amount offered to beginners at the Glasgow centre, applications for positions at this rate of remuneration being exceedingly numerous. With lengthened service the remuneration is increased at the rate of an additional 1s. per week for each year. One operator is at present in receipt of £1 per week, several others receive 12s. per week, others 11s., and so on. The allegation that the girls have in turn to attend the exchange at an early hour to do the work of a charwoman will no more bear investigation than that respecting the wages. The charwoman is not permitted to touch the switchboards for the reason that she would most probably injure them if she did, and the duty of dusting them is allotted to the girls themselves as the most competent persons to perform the necessary operation. But, if they attend earlier in the day to do this, they are permitted to leave earlier in the afternoon, as a set-off. Then, with regard to the supposed severe strain upon the operators, that, if there is any such, lasts only for a short time, the greatest press of work being confined to very few hours each day. The girls do not present the appearance of being severely tried by their labours at the switchboard; on the contrary, they impress an observer rather as being an unusually fine, well-looking body of young women. Their convenience and comfort are well looked after, the switch-room is electrically lighted and well ventilated, and, as a whole, the young ladies appreciate and are satisfied with the efforts made for their comfort and happiness. It is difficult to perceive the motive for the penning of the letters of complaint, and it is by no means certain that "One of Them" was one of them

at all, for every girl denies that she was the writer of the first or of any subsequent letter. Names were attached to some of the later letters professing to be those of operators, but we are assured that there are no girls bearing the names given in the Glasgow exchange.

RUMOURS relating to the movements of the Copper Syndicate have been numerous during the week, and have varied from day to day. First came the statement that the contracts with the copper producing companies had been revised and extended to 10 years. Later it was said that the leading Spanish company had consented to an extension to 12 years. The American companies have also been approached upon the subject, and there seems to be but little doubt that some arrangement of the kind is now, or soon will be, in existence. It is said to be the intention that London houses shall lead in the administration of affairs, and that some of the most powerful financial firms will form a group acting in harmony with the Paris interest. What interests us most nearly is the question of price, but regarding this it is said that nothing definite has yet been formulated. The price to be paid to the companies for their copper, one authority states, is to be increased, and in the view of that authority that will stimulate the opening out of fresh mines, thus merely postponing the evil day for the syndicate, for which is anticipated a great day of reckoning.

THE HAMPTON WICK RAILWAY ACCIDENT AND BLOCK SIGNALLING.

THE official report of Major Marindin, the Board of Trade officer appointed to enquire into the circumstances of the collision which occurred at Hampton Wick, on the London and South Western Railway, on the 6th of August last, has now been issued.

The details of the accident are probably still pretty well within the memory of our readers. The Bank Holiday traffic had been fairly disposed of, when an engine was required to return from Kingston, where it had just arrived with its train, to Twickenham, in order to bring on the Kingston portion of another down train. This engine started on its return journey from Kingston on the wrong—that is, the down—road. Its departure was duly observed by the signalman, but the fact that it was travelling upon the wrong line was not apparent to him for some seconds after it had started; indeed, not until it was fairly on its way to Hampton Wick, the adjoining station.

In the meanwhile a down train with passengers had been signalled to Kingston from Hampton Wick. The two trains, viz., the empty engine and the passenger train, thus travelling upon the same line, came into collision just as the latter was approaching Hampton Wick Station prepared to stop there. The empty engine left Kingston at 11.55 p.m. and collided with the passenger train at 11.56, so that it will be seen from the time occupied in running the distance that the space between the two points was not very great, and that it afforded but little time for thought or action on the part of any of the officials concerned.

The return of the empty engine to Twickenham for the purpose of bringing forward the Kingston portion of the late down train was exceptional, it being by no means usual. Ordinarily, the engine having done its work would cross over to the engine shed; and on this occasion it had done so preparatory to being stalled for the night, when the driver and fireman advised the signalman the engine had to return to Twickenham. The signalman, forgetting for the moment the arrangement of his roads, hurried the engine off so that its presence might not delay a train about to follow. Thus it happened the engine took the wrong road. There are, as usual, telelegraph posts on one side of the line only. There were eight posts between the two signal boxes on the down side of the line, and which were, of course, near to the driver of the empty engine. These with other objects ought to have attracted his attention but they did not, and it was only when "on reaching a point about 373 yards from the place where it started, both men on the engine discovered by the light of the Hampton Wick up-home signal shining on the wet rails, that they were on the wrong line." 279 yards beyond this the collision occurred. The evidence would appear to point that the engine when it passed through Hampton Wick station was travelling at a high rate of speed, and that this speed had been very little reduced when the engine met the passenger train drawing into the station.

With such an industrious and painstaking officer as Major Marindin, it was to be expected that the question of speed would be fully investigated. In order to see what would be the effect of acting exactly in the manner described by the driver and fireman, he started from Kingston Junction signal cabin upon an engine of precisely similar pattern, with the same pressure of steam, and made two runs to Hampton Wick. Unfortunately, the rails were dry, instead of being damp and greasy, as they were on the night of the accident. In the first run, on the engine attaining the indicated speed and reaching the required spot, it was stopped within 106 yards; and, in the second case, within 123 yards—the speed in this case having been increased from 28 to 33 miles, and the point at which the efforts to stop the engine were made being 111 yards nearer the point of collision. The evidence is thus very apparently against the men on the engine having kept that look-out required of them. Obviously, the collision was due, as stated in the report:—First, "to the blunder of the Kingston signalman;" and, secondly, "to carelessness on the part of the driver and fireman of the light engine."

Here, however, Major Marindin touches upon another phase of the occurrence. The speed at which the light engine travelled, and the short distance it had to travel, afforded but one minute between the time of its starting and the time at which it came into collision. The line is worked on the block system, and although provision is made for a bell signal, such as would have met the case in view and caused Hampton Wick to throw on his signals in the face of the engine, it is questionable if it would have been of use, as, according to Major Marindin's report, it would occupy some 20 seconds to transmit it, so large is the number of bell-beats which represent the signals to be rendered. On this point Major Marindin says:—

"As it is possible that the signalman at Hampton Wick might have averted the collision by throwing up his signals against the light engine, if he had been warned in time, I would, as a fourth cause of the collision, mention the want of some very short code or other telegraphic or telephonic signal, on receipt of which a signalman must at once throw all his signals to danger. The present code signal is too long for use in a sudden emergency, and, moreover, as there appears to be some doubt as to which of three would have been the right signal to have given, the regulations on this head should be made more clear."

We quite concur in the desirability of such a signal as can be readily transmitted for stopping trains, where such is necessary. We are not, however, quite clear it would be judicious to adopt such a signal as that proposed by Major Marindin. We would rather ask whether it is not possible to secure the end desired by some signal more direct in its application to the object to be attained. We cannot but think that where a signal is thrown on in the face of an approaching fast train, the ready application of the breaks, and possibly the reversal of the engine, may be attended with some risk. Of course, where it is necessary, it is all very well; but the adoption of such a signal would be sure to be applied in some instances where it was not

needed, causing alarm to the passengers, if nothing more.

We have been under the impression that most bell codes provided for the stoppage of "vehicles or engines running away on the wrong line," as also for vehicles running away on the right line—that is where they have broken loose and gone away on a falling gradient. It is needless remarking such signals are very necessary. The main point is that they should be so framed as to require but little time in transmission. We are glad of the opportunity—sad as the circumstances are which give rise to it, to direct attention to the subject. It is undoubtedly a signal seldom used; but for all that, it is of so important a character, that when required it must be short and quick to be of service. The present is a striking case in point. A practice prevails of crowding a large number of signals into the bell code. We question the propriety of this. If so many signals are really necessary, we very much incline to the opinion that some further adjunct is needed—a telephone or some form of indicating instrument—indeed, in the present case, it is just possible that had the signalman been able to speak Hampton Wick readily upon a telephone, it might have been effectual in preventing the loss of life which followed the mishap. The question is one which intimately concerns our railway electrical engineers, and we have little doubt it will receive from their hands the attention it deserves.

PHENOMENA OF MAGNETIC PROPAGATION.

By Prof. ELIHU THOMSON and MERLE J. WIGHTMANN.

THE numerous instances in which different minds have simultaneously, or almost simultaneously, followed the same channel with a similar outcome in results, especially in the field of invention and discovery, is almost sufficient to convince one that the mental processes are but illustrations of the general evolutionary process.

In no field have there been so many instances of this kind as in the rapidly-developed and developing electrical field. Indeed, this is natural, since in a field which is developing very rapidly, or in which many discoveries or inventions are being made in a comparatively short period, it is to be expected that if independent discoveries or inventions are made by different persons they are most apt to occur at periods not very far apart.

The authors have noticed recently a published account of a new meter for alternating current work, invented by Mr. O. W. Shallenberger, of Pittsburg.* It is chiefly interesting from the fact of its containing certain elements of a novel character by means of which a continuous motion or rotation is produced from alternating currents. The authors have been at work for some time past in almost identical lines of experiment, with the result of independently arriving at the same device which Mr. Shallenberger has shown in his meter, together with a number of other interesting and curious combinations of devices which give rise to motion from a single alternating current circuit, and without the existence of a separate branch or circuit of different phase of alternation, such as has been described by Prof. Ferraris. It is needless to say that the work of Mr. Tesla has involved the use of two alternating currents of different phase.

A conductor or coil carrying alternating currents may be conceived of as throwing off with each pulsation of current lines of force or magnetic waves. The waves of magnetism propagated from the ends of a coil in which the alternating currents flow seem to be in a manner analogous to the puffs of steam emanating from the exhaust of a high speed engine. With magnetism we would, of course, have two different kinds of puffs, corresponding to waves of different signs. To obtain rotation from the puffs of steam we have only to cause them to impinge against the blades of a small paddle-wheel. It was found that the magnetic puffs also produced rotation when they were allowed to react on the edge of a centrally-pivoted disc of iron, as shown in fig. 1. In this case the core, B, of the magnet, A, was prolonged at one end of the coil. A light and delicately-pivoted iron disc, D, placed with one edge near to the iron core at any point along its length, was set into quite brisk rotation. The tendency to cause rotation was greatly increased when the portion of the core projecting from the coil was of unlaminated iron, and still further improved by the use of steel. The action was then so vigorous that the disc would rotate at the outer end of a core even at a distance of three or four feet from the coil, the wound portion being nine or ten inches in length.

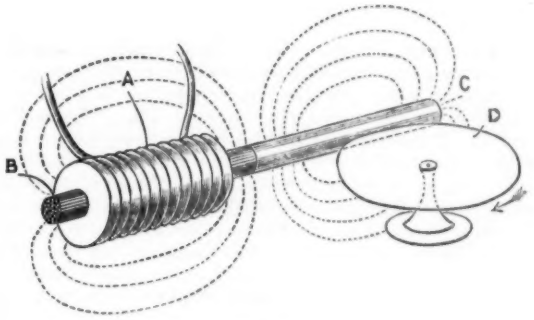


FIG. 1.

The explanation of these phenomena seems to be that as the circuit of lines of force from the coil, A, expands, a great number of lines endeavour to follow the iron path offered by the core, C. The iron core, especially if unlaminated or if of hard metal, offers a hindrance to a sudden passage through it of magnetic lines, that is, each magnetic wave as it advances along the core has a certain amount of work to do in turning over the molecules in a position of new and reversed polarity. This work of polarising or changing the polarity of the molecules of the core requires an appreciable time, so that the magnetic polarity rolls or is propagated along the core in the form of a wave. The increased effect of the unlaminated core can be explained by the fact that it offers greater hindrance to the progression of magnetism on account of internal induced currents. The waves in consequence are forced to move slower, and a greater number of the lines of force of each wave appear externally to react on the disc.

Hard steel offers an additional hindrance, due to its greater magnetic friction or resistance of the molecules to polarisation.

It seems to follow from the fact that rotation ensues with such a long length of core as mentioned above, and that the waves of opposite polarity follow each other in rapid succession throughout its whole length, there might exist at any instant one or more consequent poles after the manner illustrated in fig. 1. These progressing waves or poles induce poles of opposite signs in the adjacent edge of the disc, and as they advance attract those of the disc, causing it to rotate.

It is beyond the scope of the present paper to enter into all the theory of actions of the devices described. It is evident that the above device alone offers a field, the thorough investigation of which would more than overreach the limits of such a paper.

In these experiments we have a beautiful exemplifi-

* See ELECTRICAL REVIEW for September 28th.

cation and proof of the existence of a true magnetic friction as well as the retarding effect on the development of magnetism due to the induced currents set up in solid bars. We have found that even when the core is thoroughly laminated the magnetism travels in the same way, though the effects are feebler, due to the absence of induced currents. The knowledge of this would naturally lead to the arrangement shown in fig. 2, which, however, in substance, preceded with us, the experiment shown and described in connection with fig. 1.

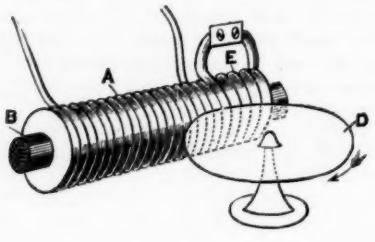


FIG. 2.

In this experiment a closed circuit, such as a band of copper or a coil, E, the terminals of which are joined, was located at some position on the magnetisable core in addition to the alternating current coil. The position shown is at one end of the core, where the strongest effect was found to exist. This coil may overlie or underlie, or be a portion of the coil through which the alternating currents are passed. The closed circuit then becomes the seat of induced currents, and these currents act to hinder the development of field at that part of the core on which it is located—that is, the magnetic waves from the alternating coil are caused to slow up in passing through the closed circuit coil, and in consequence more lines are forced out from the side of the core. This is equivalent to the propagation of a consequent pole along the core over that portion covered by the closed coil. The application of either the edge or the flat side of a disc of iron, D, to such a construction of core and winding results in rotation as in fig. 1, and for similar reasons. It is a fact, which at first seems very

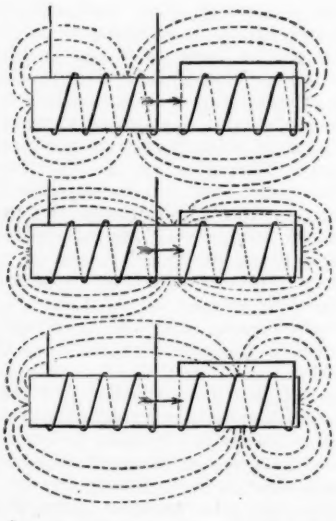


FIG. 3. FIG. 4. FIG. 5.

remarkable, that the disc may be applied at any position along the length of the coil and undergo rotation in the same sense. The most powerful effect is found when the centre of the disc is located in a line which divides the two windings.

Reference to drawings 3, 4, and 5 will assist in making this section clear. The dotted lines represent the probable distribution of magnetism at three successive instants of one alternation. The fact before referred to is not difficult of explanation when we consider that both the alternating and closed coil have currents circulating in them differing in phase. Both of these currents circulating around the same core must have their respective magnetising influence upon that core. The influence of the alternating coil, as stated in regard to the experiment of fig. 1, extended over several feet of core. It follows, therefore, that the currents in the closed coil should also affect a considerable length of core, and exert the retarding influence even to the centre or outer end of the exciting coil.

Referring to fig. 2 it is evident that we might have closed windings at each end and operate on two or more rotary armatures, or we might bend the magnet in such a form that both ends acted to propel the same armature. Fig. 8 shows an adaptation of the principle described to a simple motor device, in which the effect of both ends is utilised. It consists of a laminated closed core of iron, wound with three separate coils, one of these coils, *a*, in which an alternating current is sent, tends with each alternation to produce consequent poles on a line marked N, S. The other windings consist of closed circuits covering opposite quarters of the ring at one side of the line joining the poles. The action of this arrangement will be easily understood from the explanation of the action of the device shown in fig. 2. The induced currents in the closed coils, *b*, *b*, cause the poles which would naturally be produced on the line N, S, to first appear at N′, S′, or even further in that direction; but the retarding effect of the coils, *b*, *b*, being exceedingly temporary, they immediately shift to the position, N, S. This appearance and immediate shifting of poles, of course, occurs with every alternation. A disc of iron or copper, or an armature with closed circuits wound upon it, when mounted within the ring, will rotate with considerable energy. An excellent form of armature for this device consists of an iron core covered with a sheathing of copper and provided at each end with flanges extending up on both sides so as to be acted on by all the lines of force except those extending from the outer edge of the ring. In this case the ring was mounted vertically. The device used in our experiments was provided with windings on all four quarters. With this construction rotation in either direction could be produced, depending on which pair of opposite circuits are closed upon themselves. It will also be evident from what has been said that the same effect could be produced with only one winding, provided a portion of the turns upon opposite quarters are short-circuited.

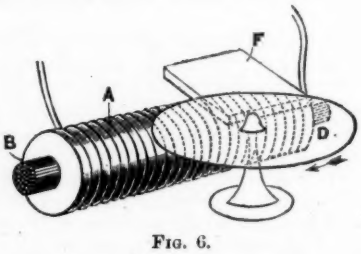


FIG. 6.

Fig. 6 illustrates another method of producing the retardation of magnetism. In this device the closed band or coil, E, of fig. 2, is replaced by a stout piece of sheet copper, F, which is inserted between a portion of the disc and the alternating coil, A. The best effect is obtained when the centre of the disc is on a line with one of the traverse edges of the copper plate. A portion of the lines of force propagated from the coil, A, tend to pass through the overchanging side of the disc, D, in completing the magnetic circuit. A portion of them have to pass through the copper plate before reaching the movable disc, and owing to opposing induced currents set up therein, are retarded or delayed behind those which reach the disc without having to pass through the plate. The effect of this is equivalent to

that of the consequent shifting pole of the device of fig. 2, and rotation results. Fig 7 is a modification of the device just described, by which almost all the lines of force from the coil, A, are caused to enter the disc, therefore producing more powerful effects.

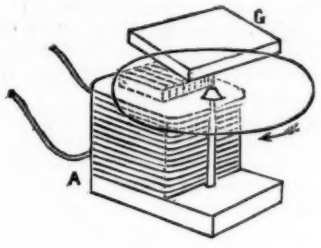


FIG. 7.

Fig. 8A is a still further modification. A ring or coil, closed on itself, H, is substituted for the plate G, fig. 7. This coil is let into a recess in the pole, so that the disc or armature, D, can be brought very close to the core of the alternating magnet. Two such magnets applied to opposite sides of the disc increase the effect, and tend to balance each other's direct attraction or repulsion for the same.

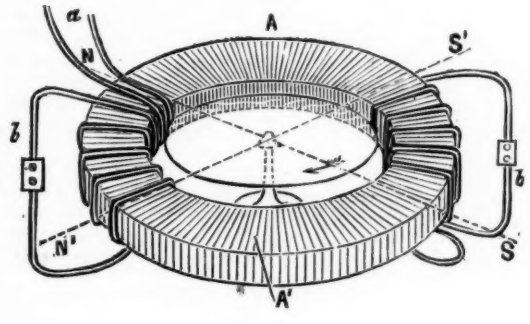


FIG. 8.

Fig. 9 shows a form of construction from which increased effects are obtained, due to a lowering of the magnetic resistance. It consists of a ring of laminated iron, B, having a slot cut in it radially, sufficiently wide to allow the disc of copper, D, to revolve freely

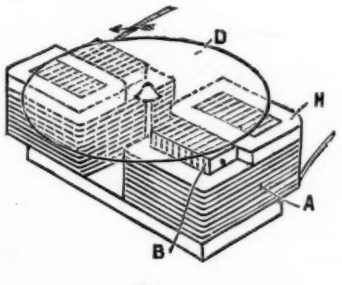


FIG. A.

between the poles thus presented to each side of it. A quarter of the ring is cut away in order to show more clearly the disposition of the closed coils or bands. These are let into the traverse grooves in the face of the pole. In this experiment a number of grooves were cut and a separate band was let into each groove, the bands being always closed upon the same side of the ring. Both faces or poles were provided with retarding coils in the same sense. The effect of this device, when an alternating current is passed through the exciting winding, A, is to cause waves of magnetism to flow across or between the polar faces in the direction of the arrow. The effect of the divided closed band is to cause each successive pole or portion of polar face, in the direction mentioned, to be retarded a little behind the previous one. This is due to the fact that the first or lower portion of the pole is not encircled by any closed band, the next portion is surrounded by one band, the third portion by two bands, the fourth by

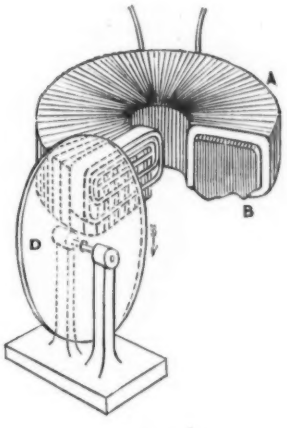


FIG. 9.

three, or, in this case, all of the closed conductor. If the edge of a copper disc is introduced between the polar faces, it tends to rotate for the same causes as were present in the previous cases. The disc is the seat of induced currents, which are reacted on in a similar manner to the poles which were induced in the iron disc.

It may assist to a more perfect understanding of the effect described above to consider them as the result of the reaction on one another of parallel and opposing currents. This we can do with all of the devices de-

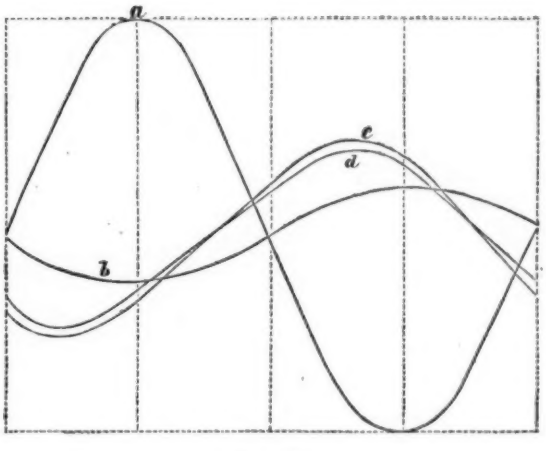


FIG. 10.

scribed except that of fig. 1, where a laminated core was used. Here we have almost entirely to deal with the sluggishness of iron to changes in magnetisation. Of course, conductors carrying currents react on each other only through the medium of the magnetism developed around them, so that, strictly speaking, we

should only consider the magnetic effects. However, we know that unlike poles correspond to parallel currents in that they produce attraction. Like poles repel and correspond in effect to opposing currents. Let us now consider one of the simple cases, from the devices described, as that shown in fig. 8A. The effect of the alternations of currents in the coil, A, is to induce currents almost simultaneously, that is currents the maximum strength of which occur at the same time, in the disc above the core, B, and in the closed winding, H. These induced currents would necessarily lag in phase up to 180 as a maximum, behind the inducing currents. The diagram, fig. 10, probably represents very nearly the actual relation of the different currents. The curve, *a*, represents the inducing current in coil A. Its effect is to produce the currents, *c*, in the closed coil, H, and also in the portion above the core B, the current, *d*, slightly weaker on account of the greater distance from the inducing current. The portion of the disc which is above that part of the core encircled by the winding, H, has also a current induced in it, but this current lags more behind the current in coil A than the currents induced in coil H, from the fact that the magnetism from the coil A is retarded by currents in H before reaching the disc.

The curve, *b*, represents this current. It will be seen that the currents, *c*, *d*, in the disc and coil, H, are in like direction, and occur simultaneously. The result is that those currents in the disc tend to place themselves directly over the coil, H, and in so doing carry the disc with them. It will also be seen that the effect of the currents, *a* and *b*, is to repel, but the current, *b*, must necessarily be comparatively weak, and consequently has little effect on the general result. The currents, *b* and *c*, also react on one another during a portion of a phase of alternation with a preponderating tendency to attract. This effect is probably nearly balanced by the repulsive action between *a* and *b* just mentioned, so that the current, *b*, adds nothing towards the rotative effect, but is used up in wasteful heat. It is evident that if we could dispense with the current, *b*, although the power of our motor would not be altered much, the efficiency could be considerably increased. This is doubtless impossible to obtain without commutation. The authors have constructed several devices embodying this idea, the details of which cannot now be given.

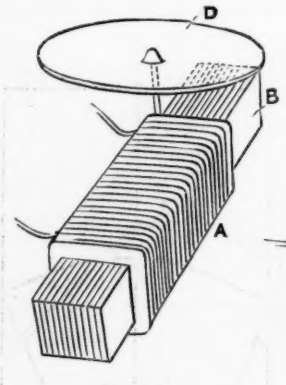


FIG. 11.

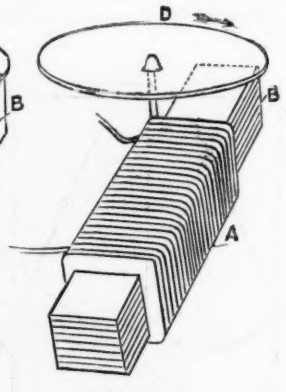


FIG. 12.

A curious and interesting experiment is illustrated in figs. 11 and 12. If a magnet, A, with core laminated in one direction and in which alternating currents are sent, is inclined at an angle of about 45, and its upper edge is presented to the lower side of a copper disc, rotation ensues when the laminations are horizontal, as shown in fig. 12, while no effect is produced when the laminations are vertical as in fig. 11. The explanation of the phenomena is very simple. Lines of force are propagated in all directions from the iron core, B. Part of the lines which reach the disc pass out from the end of the core, while another part reach the disc directly from the upper side. When the magnet, A, is placed as in fig. 12—that is, with the laminations horizontally—those lines which come out directly from the upper side of the magnet, have to pass through the plates making up the core, and the result is the production of induced or eddy currents in those plates. These currents hinder the flow of magnetism, as in the devices previously described, so that the magnetism from the end of the core strikes the disc first. The wave of magnetism which reaches the disc consequently flows in the direction of the arrow shown, and causes the disc to follow the same direction of movement.

When the laminations are vertically placed in relation to the disc, no rotations occur, from the fact that all the lines of force coming from both the end and the upper side of the core strike the disc simultaneously.

This experiment illustrates very forcibly the desirability of arranging the laminations in electrical apparatus, in which a change of magnetic strength occurs, in such a way that the lines of force can never travel in any other plane than that of the laminations. If, for instance, an armature made up of laminated or punched rings is too short for its field ; a number of the lines of force would pass in through the side of the end plates, and wasteful eddy currents would result.

The figures which are here produced show in elementary form various dispositions which have been applied in a more extended way to the construction of fair-sized alternating motors operating without any commutation. Of course, it will be evident that the disposition and proportion of parts is subject to very much variation. The authors have experimented with many of these variations, and have obtained a number of curious and interesting results. The action and interaction of the various currents in their different positions offer a wide field for investigation, and one in which our friends who are fond of somewhat difficult mathematical problems might employ their best efforts.

SOME POINTS IN DISTRIBUTION BY TRANSFORMERS.*

By LUDWIG GUTMANN.

THE distributions by transformers,† having in their primary circuits a pressure of 1,000 volts, have been attacked and considered dangerous ; another system has been proposed of a tension of 300 volts.

It would not be wise to reject a system without sufficient proof of its danger, just as it would be very wrong to adopt another of which the safety has not been demonstrated.

As the comparative merits may be of interest, I shall,

* New York *Electrical World*.

† I wish to call attention to the fact that medical coils, potential raising and reducing coils are called without distinction "converters." This name is too vague ; it may mean as well an African missionary, as any mechanical or electrical apparatus which changes natural force or matter into a more convenient form. It is necessary that a special name be adopted for potential reducing or "safe system" coils, especially since the advocates of the continuous current have already diverted the attention of the people from the continuous current for capital punishment, which would, of course, give the public the impression that alternating currents and their distribution by means of transformers are more dangerous. How can we expect the public to know the difference between "safe system" coils and potential raising coils, if electricians do not make any distinction? The present state is injurious to transformer distribution, and leaves a powerful weapon in the hands of the supporters of the continuous current. A better name to adopt for coils reducing from *high to low* tension would be "transformer," which term is not so common, and appeared first with the parallel system and originated with Messrs. Zipernowski and Blathy. Two other simple names are "changer" and "reducer." For potential raising coils the name of converter may be maintained.

in this paper, endeavour to show by figures the respective reliability and safety of a 2,000-volt, a 1,000-volt, and 300-volt system. In case of a ground in a transformer, from the primary coil to the secondary direct, or indirect, through the core to the secondary, it is necessary that the insulation of the primary coil be damaged, and the bare wire be in close proximity to the core or the secondary coil. In either case it would be evident that more or fewer turns of the primary coil would be cut out of circuit, its length would be reduced and the resistance decreased. The greater the change in resistance of the primary coil, the greater will be the current that is forced through the primary fuse. We have, therefore, not to do directly with the current itself, but with the pressure employed and the resistance of the coils, or the rate at which the resistance can alter.

Let us now compare three systems worked with 2,000 volts, 1,000 volts, and 300 volts. For example, I use a transformer of the same capacity in each case, say one that supplies 80 lamps at 50 volts and 1 ampère per lamp. To simplify matters I will assume that there is no loss in the apparatus by transformation. The work which the secondary and also the primary have to perform is $50 \times 1 \times 80 = 4{,}000$ watts. This work is equal in all three cases, but as the pressure is different the currents in the primary coils are also different, and are found to be in the 2,000-volt, 1,000-volt, and 300-volt system respectively :

$$\frac{4{,}000}{2{,}000} = 2 \text{ amps.}; \quad \frac{4{,}000}{1{,}000} = 4 \text{ amps.}; \quad \frac{4{,}000}{300} = 13\,33 \text{ amps.}$$

The virtual resistance in the primary coils at maximum load would be respectively :

$$\frac{2{,}000}{2} = 1{,}000 \text{ ohms}; \quad \frac{1{,}000}{4} = 250 \text{ ohms}; \quad \frac{300}{13{\cdot}33} = 22{\cdot}5 \text{ ohms.}$$

The virtual resistance of the secondary coils in all three cases would be $\frac{50}{80} = {\cdot}625$ ohm. I assume that (for practical purposes) the change of resistance in the primary coil which can take place is from normal to that of the secondary circuit, and is respectively : 1,000 : ·625 ; 250 : ·625, and 22·5 : ·625, or the ratio of change would be as :

$$\frac{1{,}000}{{\cdot}625} = 1{,}600 : 1; \quad \frac{250}{{\cdot}625} = 400 : 1, \text{ and } \frac{22{\cdot}5}{{\cdot}625} = 36 : 1.$$

Now, let us suppose that in all three coils a ground takes place which cuts out, say, one-fifth ($\frac{1}{5}$th) of each coil ; the rate of change of current or the strain on the fuse will be, respectively, as 1,600 : 400 : 36, or if we call that of the 300-volt system one (1), we have the ratios respectively : 44·44 : 11·11 : 1.

These figures show that the same ground in the three converters has not the same effect, but that the current developed, and, therefore, also the strain on the primary fuse, is in the 2,000-volt system 44·44 times ; in the 1,000-volt system 11·11 times as great as in the 300-volt system. Hence it follows that the safety of the secondary circuit with which the public has to come in contact is in the same proportion to these figures.

These ratios are more striking still if 100-volt lamps would be used with the 300-volt system, which would probably be done to compensate for heavier expense of primary conductors. In this case they will be found to be respectively as 177·77 : 44·44 : 1, or the 2,000-volt system is 177 times, and the 1,000-volt system 44 times, as safe as the 300-volt system.

As a matter of fact, the resistances of the primary and secondary coils are nearer equal to one another the less these two circuits differ in pressure, and, if a slight ground occurs, it does not follow at all that the fuse will break in a 300-volt system. On the contrary, fuses are here no protection whatever, and we have in such a case the 300 volts in our secondary circuit without knowing it. To demonstrate this, let us continue our first-mentioned example. I will assume that a slight ground occurs in all three transformers, so that the current in the 300-volt coil will rise from 13·33 ampères to 16 ampères. This would not by any means cause the fuse to melt, but would allow the higher pressure to enter the secondary circuit. The ratio of this rise would be :—

$$13{\cdot}33 : 16 = 1 : x, \text{ or } x = 1{\cdot}2.$$

The rise of current in the three transformers would be respectively : $1{\cdot}2 \times 44{\cdot}44 \times 2$ ampères ; $1{\cdot}2 \times 11{\cdot}11 \times 4$ ampères, $1{\cdot}2 \times 1 \times 13{\cdot}33$ amperes ; equals 106·656 ampères, 53·328 ampères, 15·996 ampères. The currents which have to pass a 2-ampère, a 4-ampère, and a 13-ampère fuse have changed into 106, 55, and 16 ampères

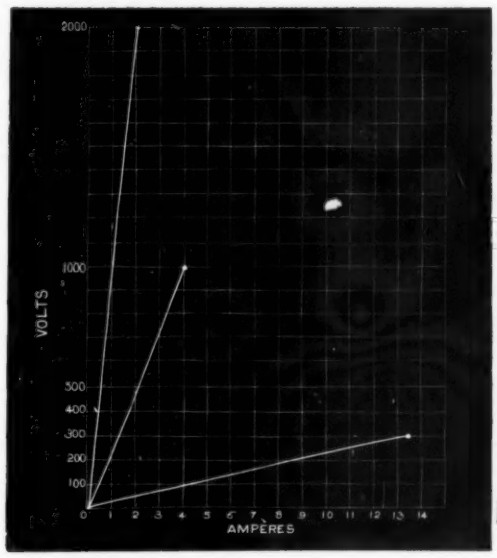


FIG. 1.—EXTERNAL CHARACTERISTICS OF TRANSFORMERS.

respectively, I would like to ask whether a 2-ampère fuse can carry 106 ampères ; if a 4-ampère fuse can carry 54 ampères, and whether a 13-ampère fuse which has to carry this current constantly will melt with 16 ampères ?

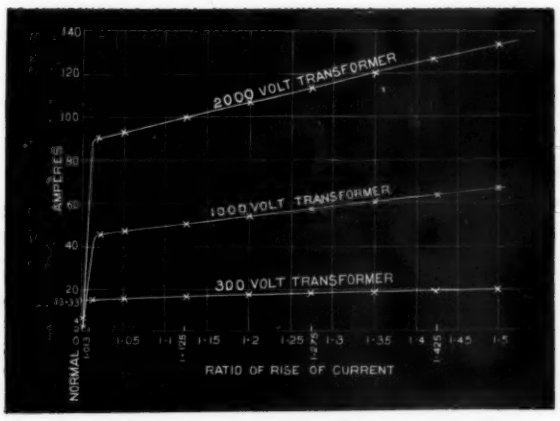


FIG. 2.—RATIO OF RISE OF CURRENT.

My former paper might have given the impression that the reliability depends on the fuses themselves, but these figures show that the fuse, however well or badly made, enters little into consideration, and that it is the nature of the transformer system that makes the fuses reliable or unreliable. This reliability does not alter in direct proportion to the tension employed, but

as the square (second power) of the quotient of the pressures of the two transformer systems compared; $\frac{2,000}{1,000} = 2$, and $2^2 = 4$. The 2,000-volt system is four times as reliable as the 1,000-volt system. These figures agree also with the first ratio found, $\frac{2,000}{300} = 6{\cdot}66$, and $6{\cdot}66^2 = 44{\cdot}35$. The 2,000-volt system is 44 times as reliable or safe as the 300-volt system, $\frac{1,000}{300} = 3{\cdot}33$, and $3{\cdot}33^2 = 11{\cdot}099$. The 1,000-volt system is 11 times as safe as the 300-volt system.*

The reason for this fact is obvious. In transformers of the same type, and with equal number of alternations, the counter pressure developed is proportional to the length of wire under induction: therefore, the primary wires in these three coils have a length respectively 6·66 : 3·33 : 1. Again, the work done in all three cases is equal, but is also equal to volts × ampères. It follows, therefore, that the currents stand in the reverse ratio to the pressure, and are respectively 1 : 2 : 6·66. If we now consider that by a ground not only a length of wire is cut out, but also that the ampère-turns are reduced, we at once see that the number of turns cut out for the same fault, or for equal reduction of ampère-turns, stands in the same ratio as the pressure, and, therefore, the effect must be as the square of the quotient of the pressures compared.

Fig. 1 of the accompanying diagrams shows the currents under normal conditions, and fig. 2 represents the change of currents in the three transformers for equal faults. The rise of current in the 300-volt cost is taken as the basis.

I must admit that 300 volts in the primary circuit is several times less dangerous than 1,000 volts, but with due precautions and proper training of linemen there will be but little danger, while on the other hand, the public, as shown above, is exposed to 11 or 44 times as much danger of a shock from the primary current in the 300-volt system.

MAGNETISM IN WATCHES.†

By C. K. GILES.

IN introducing the subject, Mr. Giles enumerated a series of questions that had been propounded relative to the variation in watches, and then considered the effect of magnetism, bringing forth some novel ideas and striking illustrations. A summary of his paper follows:—

First, let us investigate the general conditions and lines of force with which we have to contend. This condition, called magnetism, exists everywhere; it is the primary law, the ultimate fact; it is "inter-etheric and cosmic," and exists throughout matter and space—it is the dual force of nature, *at rest*. The normal condition of the molecules of all matter is one of polarity, generally called positive and negative. Magnetism, as it exists in matter, is only a condition, and the directive force of this condition in the molecules of matter, or atmosphere, or ether, is polarity, and this polarity creates, or is itself, the line of force, and the intensity of this polarity is the strength of these lines of force, and the inter-etheric nature of this force extends it through more solid matter, as well as atmosphere. The molecule is the resting-place of this dual electro-magnetic force; every molecule of the atmosphere is divided into its own individual dual polarity, and arranges itself according to its neighbour; the mass of the molecules will arrange its polarity according to existing conditions. The earth is the great primary magnet, and gives us the normal condition and direction of polarity existing in matter; any disturbance of this normal condition gives us the phenomena of magnetic or electric effect. Scientists at present agree upon the molecular or atomic theory, and the latest estimate we have seen is that a cubic inch of atmosphere contains from 60,000,000 to 100,000,000 molecules; the same sized mass of brass is estimated to contain one-half this number, and so on. This electric or magnetic force exists in dual form, positive and negative, and must be in equilibrium; any disturbance of this equilibrium results in some form of phenomena—the permanent displacement or annihilation of this dual condition of electricity or magnetism would be equal to creating a vacuum in the atmosphere—neither one nor the other can be fully accomplished. All moving electric currents and magnetic conditions are looking for satisfaction—seeking their equilibrium, as water seeks its level; if this equilibrium is not found in the atmosphere or matter surrounding the earth, it is sure to be found in the earth—the earth is the great clearing-house of the disturbed equilibrium of the dual conditions. Our globe represents the aggregate polarities of all the molecules composing it, and as a mass it must be in a condition of equalised polarity. The movement of electric currents and magnetic conditions about the earth is but the means of the disturbed dual polar force to keep up the equilibrium of the whole. Electricity is the primary cause of the condition called magnetism. A bar of steel whose molecules have been put in a condition of intense polarity becomes a magnet: a piece of tempered steel whose molecules are so compact that they are not free to move, and cannot rearrange themselves satisfactorily with the normal atmospheric polarity, becomes what is called a permanent magnet, and will create a magnetic condition equal in intensity to its own, in the molecules of atmosphere or other matter which impinge on its surface. It would appear,

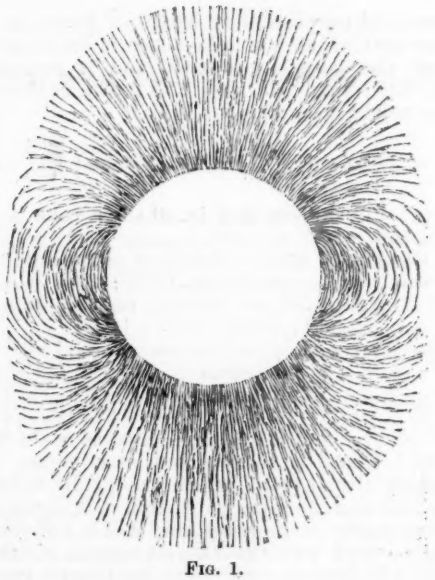


FIG. 1.

then, that the strength of magnetism, or magnetic lines of force, is the inertia of the molecules forming the magnetic centre. When this is overcome by an influence stronger than its own, the polarities change, but not until then. To make visible the lines of force, and magnetic conditions which we have to contend with in rating our watches, as well as in running a railroad, we have made some photographs of actual conditions existing, as shown by experiments, which explain some phenomena otherwise unexplainable.

We show in fig. 1 a wheel, or disc of steel, magnetised, the iron filings on the cardboard showing the

* The inaccuracy of the ratios is caused by the incomplete decimals.

† Abstract of a paper read before the American Railway Master Mechanics' Association at Alexandria Bay, New York, June 19th, 1888.

lines of force, the two poles and the equator of the forces; this may represent a single molecule, or an aggregation of molecules, or the earth—as the law which governs the single molecule is the same as that which governs the whole—nature's law of force does not recognise size; the entity of force is in the molecule; everything else is but the aggregation of molecules, the same as the individuals make the army; and the equilibrium of force must exist in any aggregation of molecules, the same as in the single molecule. Let this set of conditions represent the earth and its atmosphere; you will notice its poles and the equator of the forces, and the lines of force existing in the atmosphere, in natural equilibrium. If we take this little compass needle and pass it around the circumference of the disc, you will notice that its positions correspond with the lines of force as shown by the iron filings, and also with the record which navigators have given us of their dipping needle when sailing around the earth; on the equator it rests level; as we move it toward the pole there is a regular degree of incline to every degree of latitude; at the pole it stands perpendicular (navigators are not able to reach the point where the needle stands perpendicular, but the other records are the same, of course allowance being made for the local disturbances); as we pass the poles the incline is in the same degree until we reach the opposite side, where it rests level on the equator again, and so on to the starting point. This will make visible to you the cause of the phenomena of the changing polarity of a piece of iron as we change its position as regards the earth—the iron being magnetic itself, the direction of its polarity will be subject to the same lines of force as the compass needle—the jarring of the iron simply assists in overcoming the inertia of its molecules, so that they more completely fall into the directive force—this also shows the lines of force to which all moving matter on the face of the earth is subjected, our watches included. These atmospheric lines of force are utilised by Edison in train telegraphy; and again, these invisible lines cause practical electricians the serious trouble which they call induction. Every piece of iron or steel creates around itself a magnetic field or halo of force, caused by the magnetic condition of its molecules being more intense than the normal atmosphere. Every molecule of iron is but a small magnet, and the aggregation of these is the bar magnet, and its condition can be made more or less intense by manipulating it with more or less electricity.

FIG. 2.

The illustration, representing a railway spike, fig. 2, will show the halo of force which surrounds any piece of iron or steel—it is popularly understood, or generally expressed, that any piece of iron receives or owes its magnetic condition to an induced charge of magnetism from the earth. This is not a fact—all iron is magnetic, *per se*, and receives no more induced charge from the earth than the compass needle does from the north pole—the general magnetic conditions existing in the atmosphere surrounding the earth give direction to its polarity, but the lines of force, or condition, extend outward from the iron until equalised in its surroundings, just as the waves in still water circle outward when a stone is thrown in.

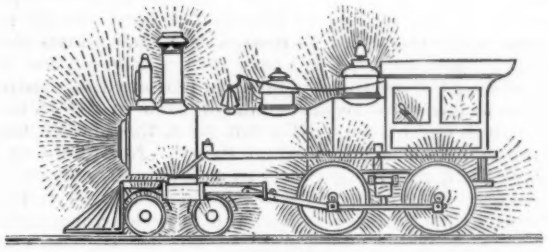


FIG. 3.

Fig. 3 shows an outline of the general magnetic conditions which surround the locomotive. These lines of force will be made more tense by the electricity evolved by the swift moving locomotive cutting lines of earth's force, as seen in the previous sketch, the effect of which, on a small scale, is the same as the dynamo; but there is less permanent magnetism in the locomotive than in the balance of the train, on account of the heat of the boiler, but there is more of the electro-magnetic conditions, and more of the rapidly changing polarities.

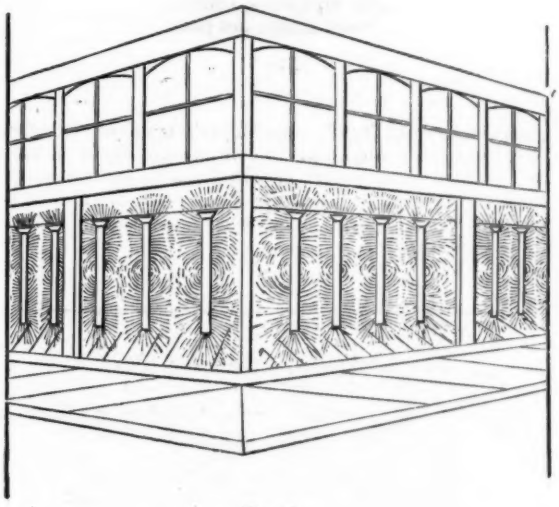


FIG. 4.

Fig. 4 again shows lines of force in any iron building, or buildings with iron columns; you will notice the two poles and the equator of force in each column, also between any two columns. This is easily proven, and shown to be practically correct by any simple magnetic field searcher—a compass needle; a dipping needle, or even a fine cambric needle magnetised, and floating on a glass of water, will show the horizontal direction of the lines of force in any set of conditions; it is generally understood that the north end of the compass needle will be deflected toward any iron body, but as a matter of fact, the attraction depends on the position of the needle relative to the iron body; the upper half of any piece of iron will attract the north, and the lower half the south end of the compass needle. This compass needle and this piece of iron (a spike) will show this—we will first test for permanent magnetism. The scientific test for permanent magnetism in a piece of iron is to lay it over the centre of the needle, holding

it perfectly level and keeping the bulk of the metal equally distant from either pole; if it does not deflect the needle it is free from permanent magnetism, as you see it now—we hold it perpendicularly, and approach the lower end of the compass needle, and it immediately responds with its south pole—we reverse the iron, end for end, and we have the same action. Now we raise the needle slowly along the perpendicular iron, and, as we pass the centre, the needle will begin to reverse, and at the top the south end is repelled, and the north end attracted. We change the molecular arrangement of a piece of iron by holding it perpendicularly and striking it gently, but hard enough to disturb the inertia of its molecules, which allows the earth's directive force to assert itself; now, putting it level over the needle as before, we will see the needle move to meet new arrangements of force in the spike, the south end of the needle will meet the end of the spike which was down when struck. Now hold the spike level, striking it gently as before, and replace it over the needle, and you will see the needle is undisturbed. We have rearranged the molecular, magnetic conditions in this spike, and you will see that we can manipulate this magnetic arrangement of molecules, as we would a tangible, physical body, and this change and rearrangement of molecules is taking place in all iron when its position is changed as regards the earth, with the consequent tendency of the molecules to group around any given magnetic centre, or any hard spot, or any condition more compact than the average of the mass. In these hard spots the molecules, being more

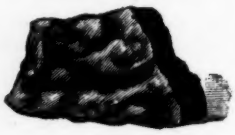


FIG. 5.

compact, are not free to rearrange themselves, therefore they hold their magnetic conditions, and form a magnetic centre for the more free molecules, and in actual work the intensity of this condition will increase with use, and might result in what is generally known as crystallisation.

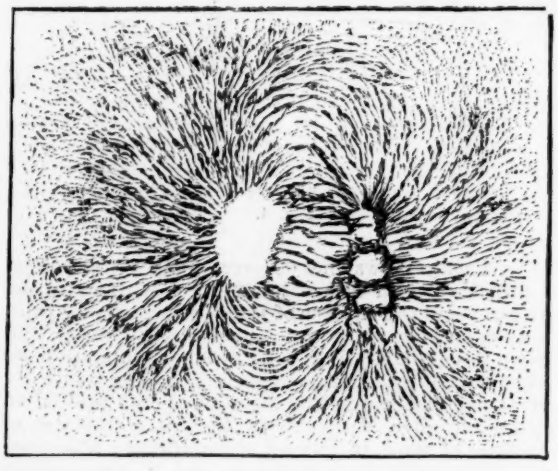


FIG. 6.

Fig. 5 shows a natural magnet—a piece of magnetic ore—this might represent a magnetic centre, a crystallised spot, a hard spot in iron, and causes a crystallised space, or hard spot, or magnetic centre, in the atmosphere. We place a cardboard with iron filings over this ore, and gently jar it, when it will show exactly how the lines of force are formed in the atmosphere surrounding it.

Fig. 6. This is only a section of the force which is extended around in all directions, as in all magnetic conditions, and probably accurately represents the first step of formation, ending in crystallisation in manufactured iron and steel. You will notice that these iron filings are held together by these magnetic conditions—you will have to use considerable force to break them—this is magnetic life, or magnetic cohesion, or a natural crystalline fibre, if you will allow the term.

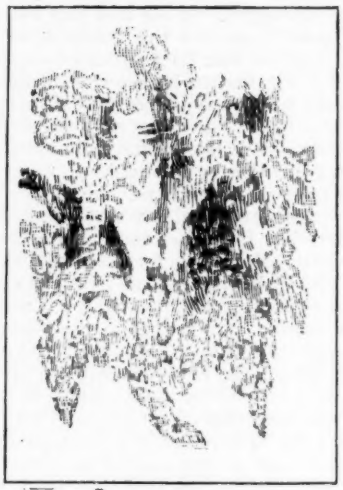


FIG. 7.

Fig. 7 is the same cardboard and iron filings, with the natural magnet removed, and the cardboard slightly jarred, and as a result you will notice that the curved lines have lost their magnetic cohesion, and have become granulated; and when this occurs in a piece of iron or steel, it becomes what is called rotten, and there will be a breakage when any extra strain is encountered.

Fig. 8 shows three pieces of steel arranged side by side with the cardboard and iron filings, and exhibits the grain of the steel, and also the several polarities or magnetic centres, or hard spots in a single piece of steel; also shows the lines of force between the pieces.

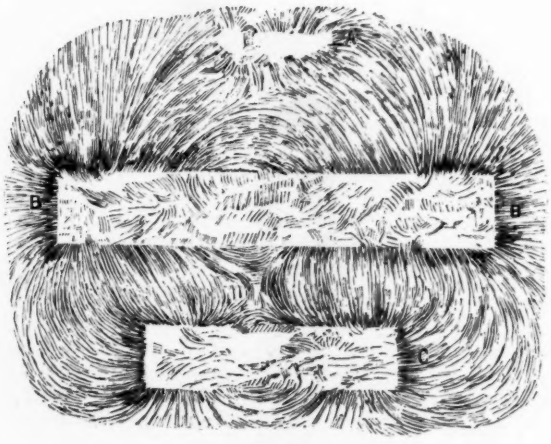


FIG. 8.

A is from a square piece, but the polarities are so intense as to destroy the outline of its form—it is a very brittle piece, and will break on slight provocation.

Fig. 9 shows the magnetic condition in and around an ordinary file, which also is brittle, breaking with a light blow.

Fig. 10 is obtained with the cardboard and iron filings over a piece of a watch mainspring which was broken during the late electrical atmospheric disturbances. There is a striking similarity of magnetic centres, or hard spots, in this piece of mainspring, to those shown in the bar magnet or file, and which are about the same as would occur if the steel in fig. 9 was rolled out to form this ribbon of metal, the mainspring, carrying the inequalities throughout the length of the spring. The whole length of the mainspring is similarly formed to

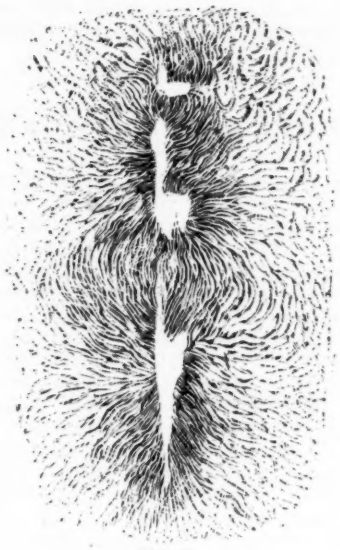


FIG. 9.

the piece shown, and as it is closely coiled in the watch during service, and these antagonistic polarities come in juxtaposition as the coils pass each other, as the watch runs down, which, taken in connection with the right electric, or magnetic and thermic conditions in the atmosphere, apparently causes a completion of the forming or crystallising conditions, and the amorphous matter between any two magnetic centres will group with, or combine with, one or the other of these magnetic nuclei, causing a lack of cohesion on the dividing line, and under the strain of service there is a parting, and we have a broken mainspring. Mainsprings, when lying in stock, are never, or very seldom, broken; it

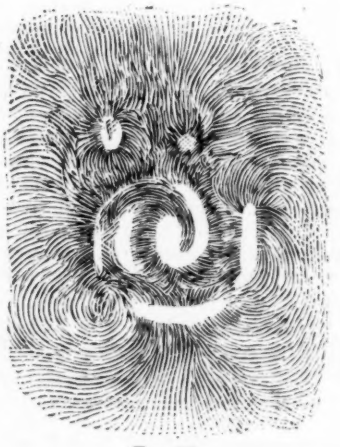


FIG. 10.

occurs only when in action. Thus we have a partial explanation of broken mainsprings in connection with electric storms. We are making further researches and experiments, which we trust will more definitely develop this interesting subject, but experience in the past four or five years has shown that surrounding the movement with a shield circle of highly magnetic metal will prevent fully 75 per cent. of the breakage of mainsprings.

Fig. 11 shows a perfect piece of steel, as discovered by the cardboard and iron filings; the fibre or grain lies straight, and there are no hard spots or magnetic centres; there is only the natural, equal division of space by the dual force; the equator of force is in the centre. This is the kind of steel sought for in the construction of watches, as its action is reliable when reduced to the delicate proportions necessary for hairsprings, balance wheels, and mainsprings. The illustrations represent chance pieces of steel, and represent the average conditions of the metal in general use. These hard spots, or crystalline spots, occur in all metal, but are still more detrimental in the non-magnetic metal where we have not the magnetic life or magnetic cohesion to assist in retaining the molecules in fibrous form or condition. These illustrations of conditions are equally instructive when applied to material to be used for locomotive building.

FIG. 11.

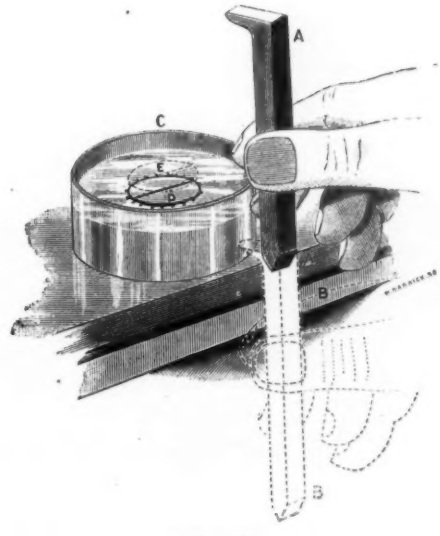


FIG. 12.

To show the different or varying influence of this spike on the balance wheel according to their relative positions, we place the glass near the edge of the table; in order to allow the spike to be moved perpendicularly, fig. 12, we hold the spike so that its lower end is about even with the surface of the water, A, B, and the balance

wheel will vibrate to the position, D. Then as we lower the spike so that its upper end is on a level with the water, B, B, the balance wheel vibrates to E, as shown by the dotted outline, and the balance wheel will be vibrated freely, by raising and lowering the spike. This will partly explain why the watch varies when on or off the train.

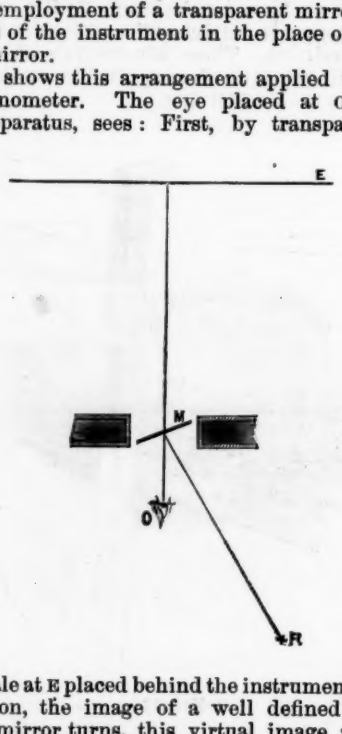
Having given a general outline of the influences in which the watches of engineers must exist, as these lines of force exist everywhere in more or less intense condition, it is obvious that so sensitive a piece of mechanism as the watch must be more or less affected.

But this universal force which exists in, and surrounds the metals of the watch—this magnetic influence—is not an unmitigated evil, but, on the contrary, is a decided advantage when under proper control—like most of nature's forces, utilised, they are of immense benefit, while their attempted annihilation is equally detrimental. This control and utilisation of the magnetic forces is accomplished by the use of a shield of highly magnetic metal, which has been found to protect the watch fully from all undue magnetic influence, and, at the same time, allowing the use of brass and steel in construction of the compensating escapement, with which alone the highest horological accuracy has been obtained, and this protection is attained by utilising the same natural law which causes the trouble, or using the same dual magnetic force to protect the watch—and we secure this result by surrounding the watch movement with a circle of highly magnetic metal, which will secure the lines of force existing in any charged atmosphere, and hold them in a complete circle or closed magnetic circuit, where all the enclosed space will be neutral, or in a state of satisfied polarity.

METHOD OF READING INSTRUMENTS ON THE REFLECTION PRINCIPLE.

THIS method (devised by Mons. F. Drouin) is based upon the employment of a transparent mirror, fixed on the needle of the instrument in the place of the usual silvered mirror.

The fig. shows this arrangement applied to a Thomson galvanometer. The eye placed at O, in front of the apparatus, sees: First, by transparency, the



divided scale at E placed behind the instrument: Second, by reflection, the image of a well defined mark, R. When the mirror turns, this virtual image appears to be displaced along the scale.

For a rotation of an angle, a, the apparent displacement of the image is, as in the ordinary arrangement,

$$d \tan 2a,$$

d being the distance of the scale from the axis of rotation of the mirror.

d can theoretically have any value, but it is eviden that it is limited for a given scale by the distance at which the eye ceases to distinguish clearly the divisions on the scale.

The arrangement allows readings to be taken in full daylight and the more easily as the room is lighter.

The mirror, M, is a plate of very thin glass with parallel faces, and it can be very light.

The mark, R, can be either a stretched wire faintly lighted or a very fine luminous line. This latter arrangement renders it unnecessary to make any proportion between the lighting of the scale and that of the mark. The light of day is always sufficient.

A PROPOSED ELECTRO-MOTOR TRIAL.

THE project of a large sleeping car company to have built for them a four-mile electrical railroad, for illustrating the advantages of each type of motor, says the *Scientific American*, will be the first really practical attempt to compare the various systems on the same line and under similar conditions. If the avowed purpose of the company may be accepted in good faith, and the projectors of the various systems will really assent to such comparative trials, we are likely to get at more cold facts concerning electro-motors than we have had for many a day. The advantages and defects of the overhead trolley system and the underground conduit plan will be exposed before critics eager to make them known. There is the curve on the plane and on grade, the straight line on grade, starting and stopping, unexpected weights and hauls, and the like. Which system can most quickly accede to the requirements, most readily overcome the various difficulties, and bear the handicapping? What are the relative advantages of taking the current from a wire overhead, and from a third rail, and from a sunken main?

The projectors of the third-rail system say that the trolley system is uncertain; the trolleys snap from their propelling wires or fly off at slight impediments, relying on the climbing capacity of the passengers in the car below to keep them in their places. On the other hand, the overhead people—we do not refer to celestial folk, who would not, of course, prevaricate about such small things as electro motors—we say these overhead people declare the trolley system to be the only reliable one; the transmission of the electrical energy being wholly removed from contact with the ground, which, as is well known, is the worst of insulation, and carried through the air, which is the best. In the use of high tension currents, they aver, and it would seem with reason, that it is difficult to protect the public, and with low tension currents slight leakages often suffice to reduce the available energy below the amount required to operate the road. Those who may have watched unprejudiced the progress of the various systems of electrical locomotion will doubtless agree that each seems to have some special virtue in the way of economy or certainty of operation. And so it is to be hoped this wealthy manufacturing company is sincere in its promise to give each a fair trial. A four-mile line would seem to be adequate for the purpose, and the neighbourhood of large stationary engines a most convenient starting point.

Cable Interruptions. — The Berne central office, under date of October 22nd, announces that the Banjoewangie-Port Darwin cables are again interrupted. On this occasion volcanic or earthquake agency is not invoked as a scapegoat, the breakage being credited to the grapnel of the repairing ship while engaged in renewing the original cable off the Lombok Straits. The engineering and electrical staff must by this time have acquired quite a valuable stock of experience in cable repairing.

THE DEPTFORD STATION OF THE LONDON ELECTRIC SUPPLY CORPORATION.

At the invitation of the directors of the London Electric Supply Corporation a large number of gentlemen connected with the various branches of the Press met at the Stowage Wharf, Deptford, to inspect the buildings and other works in course of construction at that place, which will, when complete, form a great central station from which all parts of London can be supplied with the electric current.

It is the intention of the directors to provide lines and machinery capable of running some two millions of lamps in the future, but at the present, as a commencement, they are laying down plant sufficient for the supply of 250,000 incandescent lamps of the usual 16 or 20 candle-power type; the buildings being erected will, when required, give additional space for three other sets similar to this first plant.

The grounds occupied by the company's premises cover between three and four acres abutting on the river and adjoining the Steam Navigation Company's Wharf. The river frontage forms a convenient wharf for landing fuel or the heavy masses of machinery and ironwork used in the construction and fitting up the large pile of buildings in progress. This frontage has been raised some foot or two to obviate the danger of flooding the works at the period of an extra high tide; the depth of water along the wall at ordinary high tide is about 12 feet, which will float vessels of considerable tonnage. A 50-ton iron derrick has been erected on the wharf to facilitate the unshipment of heavy materials, which are all brought by water and landed, then placed on trucks and conveyed on a railway to the buildings and unloaded at any desired point. The Corporation finds this, as was to be expected, a very great saving in the expense of transport.

The railway will be permanently laid to run straight through the centre of the block of buildings comprising the boiler-house and the two engine-houses now being proceeded with. Travelling cranes will be fitted in each of these houses to unload or to shift heavy weights.

The buildings together in one block occupy a space of 210 feet by 195 feet, and in height will approximate to 100 feet.

The boiler house, 195 feet long by 70 feet broad, is constructed to contain boilers of 65,000 H.P., and of these a number are now being erected to give steam for engines of 13,000 H.P. These boilers are arranged on two floors, the upper floor supported on iron pillars, 30 feet high, and above the upper floor will be another similarly supported, on which will be placed the store of fuel, and the supply to the furnaces will be by means of vertical shoots passing through the centre of the floors of the upper boiler room to the lower ones. To raise the fuel to the level of the topmost floor, it is proposed to construct a hydraulic lift or elevator at the water's edge, which will take the fuel up some 80 feet to the level of the store, and from thence by an elevated line straight into the building for final distribution. At each end of the boiler house is placed a chimney shaft 130 feet in height by 24 feet by 18 feet area; the interior of the shaft is divided into four flues, one of which will be apportioned to every set of six boilers. The total number of boilers on the two floors will eventually be 48. Economisers are to be provided for use if required, and no expense is to be spared to employ all the best known means of combining efficiency with economy in carrying out this enterprise.

The two engine houses are in dimensions nearly the same as the boiler house, from which they are separated by a massive brick wall, and from each other by iron pillars of immense strength, and beyond these divisions, which are destined to carry the overhead travelling cranes and the several spans of the roof, nothing will exist to prevent an unimpeded view of the whole of the engines, it being intended that the engineer in charge shall have a comprehensive view of the whole of the machinery from an elevated gallery specially provided for him. In the first engine house a pair of "small" engines of 3,000 H.P. will be erected in the course of a few weeks, they being in readiness and waiting until the roof, now in course of erection, shall afford them the necessary protection from the weather. These engines will actuate two Ferranti dynamos, each one capable of supplying current for 25,000 lights, by far the largest electrical generators that have yet been constructed; the largest now in actual work being the dynamos of this same corporation at their Grosvenor Station, which are what is known as "fifteen thousand lighters." Some 60 feet overhead, above these "small" dynamos, there will be a steam travelling crane capable of lifting 25 tons, which will traverse the building from end to end. Besides the machinery above mentioned, this section of the building will also contain the condensing and hydraulic gear, exciting dynamos, and other apparatus.

In the second engine house will be placed what the corporation's engineer justly calls the "large" engines and dynamos, of which there will be two sets. It may be confidently said that these "large" machines will be a revelation to many engineers and others who have a tolerably extended experience of big things. Here the dynamos and engines are combined in such a manner that the armature, being placed on the shaft, is driven direct at 60 revolutions per minute, and acts as a flywheel to the engines. There will be four of these large dynamos, each having its pair of engines of 10,000 H.P. eventually, but at present only half the engine power will be applied to each dynamo. When the time arrives for the creation of more power by the addition of the second engine of each pair, these large dynamos will each have its engines of 10,000 H.P., and all future extensions of the plant will be in machines of this type. To give some idea of the size of these machines it may be here stated that the diameter of the shafts is 36 inches in the centre, the armature being about 45 feet over all, and the weight of the dynamo about 500 tons. For the manipulation of the heavy weights in these machines an overhead steam travelling crane will be erected similar to that in the first engine house, but with a lifting power of 50 tons.

Thus far we have a general idea of what the London Electrical Supply Corporation establishment at Deptford will be when in working order, and ready to supply the public with its commercial commodity, the electrical current. The corporation, while constructing their great central station, have carried on and developed their original undertaking, until at the present time they are supplying from the Grosvenor Station nearly 33,000 lamps, and that station is doing about as large a business as the plant is capable of effecting. In consequence, every endeavour is being made to finish the contemplated first portion of their premises with the utmost expedition, thereby to be in a position to largely extend their connection, and to fill the numerous orders that are accruing.

The system to be employed will be the same that the corporation has worked up to now, viz., the Ferranti generator of high potential separately excited, the high potential current thus produced being converted or transformed to such as will meet the requirements of consumers with varied wants. It is proposed, however, that the tension of the current from the Deptford centre shall be some four times in excess of that furnished from the Grosvenor Gallery centre. This high tension current is to be brought to London at several points, which will be called distributing stations; at each of these points a first conversion will ensue, the transformation lowering the initial high tension; this lower tension current to be finally transformed to a voltage necessary to run the ordinary incandescent lamps.

The condition, in regard to the completion of the building, is fairly forward, the masonry shows considerable progress, the iron pillars are getting into place, and the time should not be long now before the roof will be able to be proceeded with. Until this is done no machinery can be put together. As some parts of the engines are already on the ground, it is to be hoped no delay will be incurred after the engine and boiler houses are roofed in. The concrete foundations for the smaller engines and dynamos have been laid. When the smaller dynamos are erected, they will be driven by ropes from the flywheel of the engines; the grooves in the flywheels are 40 in number to take 5-inch ropes.

Mr. Ferranti, in describing the many particulars and details relating to the buildings, engines, dynamos, cables, &c., called attention to the fact that the installation being constructed at Deptford was the largest centre for the supply of electrical current in the world, vastly outstripping any one of the kind even in the land of big schemes, America; and it will also appear that the tension of the current to be supplied to the trunk main to London is to whip creation as well; the current being driven through the mains at a pressure of 10,000 volts. It was suggested that there might be some slight danger to person or limb from such a pressure, which suggestion was answered that there was not really much more danger from 10,000 volts than from 2,500, considering that in either case a kill would be recorded, should any person be unfortunate enough to undergo a shock at that potential. Every precaution is to be taken to avoid or reduce to a minimum the chances of such a mishap befalling anyone, by paying every possible attention to insulation throughout the circuit, and by other means.

Speaking about the insulation of his dynamos and cables, Mr. Ferranti said he had tried an experiment which proved that there was no probability of sparking through this insulation; the experiment quoted was one in which he employed a 6-inch spark for the purpose of breaking through a piece of ebonite. He found that, even when the material was reduced to the utmost tenuity, there was no permeability, and from this he deduced that the thicker insulation, as used in practical work, must afford absolute immunity from dangerous breakdowns through sparking. Such an experiment, conducted in a laboratory on small, and therefore necessarily homogeneous substances, having no weak spots cannot be compared in any shape or form with a cable perhaps 10 or 12 miles in length, in which the chances of leakage and faults will be increased in an enormous ratio, certainly by many thousands to one.

It is some years back since De la Rue tried a similar experiment with his battery, having an E.M.F. of over 10,000 volts, and he also failed to spark through the thinnest sheets of insulating material, and Prof. Ayrton, using a pressure of 14,000 volts upon some core of Henley's make, found his tests bring out the same results as De la Rue's. In practice, insulation is breaking down continually, proving conclusively that no laboratory tests on a small scale can be accepted with any degree of confidence.

On the strength of Mr. Ferranti's tests it would seem that the railway companies have been induced to enter into agreements with the Electric Supply Corporation permitting the latter to run their cables by the side of the lines; these agreements are entered into with the South-Eastern Railway, the London, Brighton, and South Coast Railway, the Chatham and Dover Railway, by whose bridge at Blackfriars the leads will be brought across the Thames. The Corporation has leave to run also cables on any portion of the District Railway Company's line.

The cable to be put down as the trunk line is formed of two concentric copper tubes, 2⅜ inches outer diameter, with a special insulating material separating the tubes, the centre portion of the cable being hollow; the sectional area of each concentric tube is to be ·5 of a square inch. The cable is constructed in lengths of 21

feet each, the several lengths are then connected by expansion joints similar to those for steam pipes. The outer tube is left bare. When an Act can be obtained another cable is to be laid underground to the various distributing stations; the second one will afford more security to consumers against an accidental mishap or total breakdown.

Although there is much in this gigantic scheme which is open to comment, and to which we shall probably again refer, we trust that no such misfortune may await the designers of the great central station of the London Electric Supply Corporation, and that unqualified success may attend their enterprise and confidence in erecting such extensive premises, and their intention by installing on such a vast scale to reduce the price of electrical supply to the public at large.

The whole of the station, both architecturally and mechanically, has been designed by Mr. Ferranti personally, and the numerous novelties which are being introduced into it are fully covered by a large number of his patents.

The first two Ferranti patent dynamos of 1,500 H.P. each are nearly completed, and will shortly be erected; and two dynamos of 10,000 H.P. each will be completed in about five months. Mr. Ferranti, in designing the station and its details on the above principle, has a space at disposal, now covered with buildings, capable of accommodating 40,000 H.P., and remaining space of ground, easily available without crowding, for another 80,000 H.P. This brings up the capacity of the three acres of ground, after everything has been provided for, to the enormous figure of 120,000 H.P.

NOTES.

The City and the Electric Light.—At the meeting of the Court of Common Council last week, Mr. Pannell (Chairman of the Commission of Sewers), in answer to Mr. Stewart, said there were before the Commission six or seven applications from electric lighting companies who were desirous of lighting a portion or the entire area of the City. These applications had been referred to the Streets Committee, and the solicitor and engineer had been instructed, in conference with Mr. Preece, to prepare for the purposes of the committee a scheme on which could be based a form to be advertised, so that they might receive tenders, not only from these companies, but from any other corporation that might desire to tender for any area of the City.

Electric Light at the Paris Exhibition.—It is stated that about 4,200 horse-power will be required for the lighting of the exhibition to be held next year in Paris. Of this about 200 horse-power is to be supplied by gas engines. The lighting will be effected by 20,000 incandescence lamps and 1,000 arc lights. The work of preparation in the Champs-de-Mars is being vigorously engaged in, and it is confidently expected that the exhibition will be completely ready by the date fixed upon for the opening.

The Strand and the Electric Light.—At the last meeting of the Strand District Board of Works, letters were read from the Electric Supply Corporation, Limited, and Messrs. Deacon, Gibson & Co. (the company's solicitors), the former asking for a licence to supply the electric light to the district, and the latter urging that the application made by the company be acceded to. The company's letter was accompanied by several memorials signed by inhabitants of the district in favour of their application. Mr. Biggs pointed out that the board had already passed a resolution in favour of another company, and unless that was rescinded it was impossible to grant the application. Dr. Sandwell moved that the matter be referred to the lighting committee for consideration and report, but, after discussion, the motion was allowed to stand over till the next meeting of the board, a special meeting to be held during the interim for the purpose of rescinding the previous resolution.

Electric Light in South London.—At the last meeting of the St. Olave's District Board of Works, the Works and Finance Committee reported that, having considered the proposals of an electric light company offering to supply electricity to the district, they had instructed the surveyor to consult with the company as to the cost of the proposed system and other details.

Fishing by Electric Light.—A writer in the *Fishing Gazette* says: Experiments have been tried on the Welsh coast with the electric light in connection with fishing with nets in the sea. I am told that two nets were let down at night, one being furnished with an Edison-Swan glow lamp. That net, when raised, was full of fish; but the other, to which no lamp was attached, was almost empty. The light was then shifted to the other net, both nets were tried without lamps, and both nets with lamps. The results in all these cases went to show that the electric light attracted the fish in a most wonderful manner.

Installation at Toulouse.—Within a short time the town of Toulouse will possess a very important electric light installation. The plant will consist of eight turbines of 330 H.P. each, and four steam engines, each of about the same power. Each turbine and engine will work two continuous current dynamos. It is proposed to use the hydraulic power during the daytime for transmission of electrical energy. The construction of the entire installation has been given to the firms of Pinzuely, Lyons, and Blanchot & Co., Vevey.

Lighting of Paris Streets.—The Municipal Council of Paris invited tenders, competed for on the 25th and 26th of the present month, for a central light station to be kept under their own control. The plant will consist of six engines of 140 H.P., which, with the dynamos, will be divided into three groups. The first group will be devoted to the lighting of the markets by means of 500 glow lamps and 140 arc lights; the second division will consist of 1,000 incandescence lamps distributed in the neighbourhood; and the third group be applied to the lighting of adjoining streets, on a circuit of about 2½ kilometres, on the alternating current system, with about 2,500 incandescence lamps.

Fire at the Antwerp Electric Light Station.—The recent fire at the electric light station from which the Antwerp railway goods depôt is illuminated, seems to have been most disastrous. Nearly the whole of the electric light plant was destroyed. We learn that the mishap is ascribed to the chimney of one of the boilers setting fire to the wooden framework of the building. The installation comprised 3 engines and boilers, 3 Gramme dynamos, 2 small Siemens dynamos, and 48 Jablochkoff lights. On the second day after the accident 24 of these lights were working, and eight days afterwards the whole of the installation was reinstated.

Ipswich and the Electric Light.—At the last meeting of the Ipswich Paving Committee, when the application of Messrs. Laurence, Paris and Scott for permission to lay cables for electric lighting and power purposes under the footpaths, which had been referred to a sub-committee to report upon, came up for consideration, the chairman said a great many matters of detail were involved, and it would be better to take the matter in private. The reporters accordingly withdrew.

The Electric Light in Leeds.—The Leeds Corporation have recently received a number of applications from electric lighting agents and syndicates with a view to the installation of the electric light in certain districts of the borough, and it is probable that the whole subject will shortly be brought before the Town Council. In the meantime, the Electric Lighting Committee has instructed the borough engineer (Mr. Hewson) to prepare a scheme for lighting a sectional area of Leeds, beginning, say, with Briggate, Boar Lane, and Commercial Street, and supplying the light to all shopkeepers and others who may require it.

Dublin and the Electric Light.—The Dublin Corporation, at a special meeting held on Monday, passed a resolution in favour of acquiring from the Board of Trade powers to light portions of the city by electricity, and also to supply, in accordance with the provisions of the Act of Parliament, electricity for private uses.

Swansea and the Electric Light.—It appears very probable that before long the town of Swansea will rejoice in the presence of the electric light. The borough surveyor has been sanguine enough to report that nine times the light at present afforded by gas could be obtained by electric lighting at the present annual cost of gas. We fear that the surveyor is raising the hopes of the people of Swansea to an undue height, unless the intention is to make use of the water power at the Mumbles.

Exeter and the Electric Light.—At the last meeting of the Exeter Town Council, the special committee on electric lighting, having regard to the large increase in expenditure which would be necessitated, did not recommend that any tenders for lighting the city by electric light should be accepted. The report was adopted without discussion.

Coventry and the Telephone.—The General Works Committee of the Coventry Town Council has considered the question of the establishment of a telephone exchange in Coventry, and has resolved to take no part in the promotion of the same.

The Telephone and Football Reporting.—The evening edition of the *Sunderland Herald and Post* last Saturday, which was on the streets of Sunderland by 5.17, contained an account of the Middlesbrough *v.* Sunderland football match, played at Middlesbrough, which extended to about three-quarters of a column, and every word of which was telephoned from the reporters' box upon the field at Middlesbrough direct to the *Herald and Post* office at Sunderland. By this means the compositors were enabled to set up the report in Sunderland while the match was being played at Middlesbrough, and were ready to go to press with the full report within five minutes of the time when play was stopped. This is probably the first time that a football match has been telephoned nearly 40 miles direct from the field of play to a newspaper office. The *Herald and Post* expresses its obligations to the Northern District Telephone Company, which laid a special wire to the reporters' box for the work, and arranged the instrument so that the reporter could sit with it on his knee and speak direct to the composing room.

Commercial Cable Company.—As a reward for the efficient and intelligent work performed by their *employés*, the directors of the Commercial Cable Company have ordered a rise in the salaries all round, ranging from $5 to $25 per month.

The Belgian Field Telegraph Service.—The Belgian military telegraph service has an effective force composed of 4 officers and 210 men. It is divided into two portions, one being the field telegraph corps, which undertakes not only the telegraph work of an army in the field, but also carries out the duties of optic and acoustic signalling; the other corps undertakes the service on the permanent lines, temporarily made use of by the military authorities. The field corps is divided into three sections—two are completely equipped with material for the construction and destructions of telegraph lines and cables, while the third has in addition two waggons with workshops and forges. Each section is provided with five 6-horse waggons, carrying telegraph poles and wire, cable, insulators, tools, instruments, &c.

Action against the Proprietor of an Electric Launch.—Last week, in the Small-Debt Court at Glasgow, John Fraser, 498, St. Vincent Street, Glasgow, brought an astion for damages, assessed at £6 10s., against James Gibson, Cartha Works, Smithhills Street, Paisley, for alleged wrongful dismissal. Pursuer stated that on the 8th August last he had been engaged by the defender to manage the electric launch on the Kelvin at the Glasgow Exhibition, his term to be till the Exhibition closed. On September 22nd, however, he was dismissed without notice, and he then raised the action referred to. His Lordship decided in favour of the pursuer, and allowed him £1 16s. with expenses.

The Latest Novelty.—The latest scientific novelty, according to the *Court Journal*, is a little machine which accurately shows the amount of electricity that exists in any particular part of the body to which the machine is applied. With a little patience, remarks our contemporary oracularly, the sum total of electricity contained in the whole body could of course be ascertained.

Accident to a Reservoir.—Considerable damage occurred to the reservoir and water-pipes which supply the town of Toulon and the commune of la Seyne, from a flash of lightning which struck some of the metal conduits. *La Lumière Electrique* points out that this accident, which might have been much worse in its effects, emphasises the necessity of protecting works of this nature with lightning conductors.

Sale of Electrical Plant.—A first monthly sale is announced to take place at King's Commission Rooms, St. John's Square, Clerkenwell, on Monday, October 29th, when Messrs. Percy Huddleston & Co., will sell by auction a quantity of electrical plant, comprising gas engine, dynamos, arc lamps, cable, incandescent lamps, &c.

Hooper's Core.—Lieut.-Col. J. U. Bateman-Champain, writing from the London office of the Indo-European Government Telegraph Department, under date of July 29th, 1881, says to Mr. J. Hooper:—"I am a little adverse to writing in praise of the various materials, apparatus, and inventions used in my department. I think, however, that the case of Hooper's core may be considered exceptional, and I therefore mention the following facts, which I need not support by figures. For some weeks past the whole of the traffic between England and India has depended on the single Hooper's core cable, laid in 1869, between Bushire and Jashk. This link is 500 miles in length. A part of this cable, as you may recollect, suffered from very severe handling (in the *Calcutta* shipwreck) before it was finally despatched to the East, and it has been necessary from time to time to cut out several faults due to hastily-made joints. But the core continues in excellent condition, and although the insulation during the last year has been somewhat variable, this is known to be owing to the existence of a very minute defect, too small to be localised, or to interfere in any way with the working."

Lighting Tenders.—The Swindon New Town Local Board invites tenders (to be sent to Mr. H. Kinneir, clerk, New Swindon, by November 3rd), as follows:—For the supply of gas, or other illuminating power to, and lighting and cleaning of all lamps within the district of Swindon Town, for one year, commencing January 1st, 1889.

The "Sunbeam" Lamp.—The efficiency of "Sunbeam" incandescent lamps is said to be very high, arising from their superincandesence, being reckoned at nearly double the average efficiency of ordinary glow lamps. When run at the usual efficiency of the ordinary glow lamps, their life exceeds that of the latter; but it is advisable, when lighting large areas, to run them at the higher standard. For temporary lighting, these lamps can be run at specially high efficiency, and so prevent the necessity of having heavy and expensive plant. With the same engine and dynamo power, nearly double the light can be obtained as compared with clusters of glow lamps. As compared with arc lamps in opal globes, and using the same current, they give nearly two-thirds the light, and are absolutely steady. These lamps are specially adapted for ships' cargo lights, and are now being used on board a large number of steamers.

Personal.—Mr. A. A. Campbell Swinton has accepted the position of permanent consulting electrical engineer to Messrs. Sir W. G. Armstrong, Mitchell & Co., of Elswick.

Electric Fire Alarms.—The utility of electric fire alarms was demonstrated at Newcastle a few days ago. At twenty minutes past eight in the morning, the officer on duty at the fire brigade station was warned through the electric apparatus that there was excessive heat in the Co-operative Warehouse. The alarm was given from one of the automatic indicators of the immense building, and it showed accurately the particular section of the structure where danger threatened. In a few minutes after the bell had rung a strong force of the brigade, together with the reel and hose, reached the warehouse, which is about two hundred yards distant from the station, and they were in time to deal rapidly and effectively with what, under other circumstances, would certainly have been a disastrous fire. Through some causes yet to be explained, a number of boxes close to the bottom of a large central lift became ignited. There was no indicator near the well in which the lift runs, and thus the apparatus was working under great disadvantages, as the smoke and hot air were carried away from it, and in the direction of the upper stories of the building. Nevertheless, it acted in sufficient time to save excessive damage from either fire or water, and to establish completely its claim to efficiency. Directly the air surrounding the indicator nearest to the lift became heated to 120 degrees Fahrenheit, the alarm in the fire brigade station was rung, and in less than five minutes afterwards the officers were on the scene.

Brewery Exhibition, Agricultural Hall, Islington.—A special exhibit is made here of the Stockport gas engine, one of which is employed in driving direct a Victoria C^2 dynamo lighting up 13 Sellon 500 C.P. arc lamps in parallel. The working of this engine driving without any countershafting is so remarkably steady and even as to be worthy of an inspection. The Exhibition however closes to-morrow.

A Correction.—We beg to call attention to a letter in our correspondence columns from the writer of "A Synthetic Study of Dynamo Machines." In consequence of an oversight a diagram in last week's issue was wrongly drawn, and the writer asks readers to correct it in accordance with the diagram now given, advice which we hereby endorse. The next best thing to avoiding mistakes is correcting them with promptitude, and this the writer did immediately the paper reached his hands. We can pardon an occasional slip of this kind which is easily made, and especially in the present case, as the mistake entails no greater inconvenience on the part of our readers than to peruse the article again with the amended diagram before them.

The Durability of Core.—Opinions as to the life of a submarine cable are very diverse, for, of course, the conditions under which it is laid, and the place in which it reposes, have much to do with its durability. Even assuming that every condition is favourable, there are those who do not give a submarine cable a very long lease of life, therefore it is interesting to note any item of information which will enable us to arrive a little more closely to the actual facts. We have just received a sample of Hooper's core which has lately been returned from India, obtained from short pieces of cable recovered from the Indo-European telegraph cables in various repairs during the last few years. This core was made in 1868, and the dielectric resistance is now 4,000 megohms per knot at the usual temperature. The sample looks in as good condition after 20 years' submersion as when manufactured, and confirms the reports which have been made to Hooper's Telegraph and India-Rubber Works by the Great Northern, the Cuba Submarine, and the Western and Brazilian Companies, that except from mechanical injuries the core has proved most durable. The very excellent character of the material receives a further tribute of praise from Lieut.-Colonel Bateman-Champain, which may be seen on reference to our Notes columns.

Electrically Lighted Trains.—The explanation of the absence of light on the Glasgow Underground Railway, of which great complaint has latterly been made, seems to be that only a certain number of the trains are fitted with the electrical plant which secures illumination as soon as the tunnel is entered. There was a general impression that there had been some sort of failure in the electric lighting of the trains. We are glad to learn that that is not the case, and further glad to hear that all the trains passing over that part of the railway which is underground will soon be lighted by electricity. We suppose the day will come when our own Underground Railway will be rendered less dismal by ampler light from an electrical source. Perhaps when electricity is employed as the motive power its aid will also be called in to light the carriages. Even the long-suffering shareholders of the Metropolitan Company are crying out against the tortures to which they are subjected when passing through the tunnels, the state of which certainly does not improve with age.

Automatic Cable Working.—In some experiments tried on the Marseilles-Algiers cable it was found that the ordinary key speed with a mirror receiver was 20 words per minute. With a siphon recorder this speed could be increased up to 25 words per minute, though the operator, from fatigue, could not maintain this speed. By using a modified Wheatstone automatic transmitter the speed could be maintained at 30 words per minute.

Incandescent Lamps as Railway Signals.—Mr. W. W. Slater, of the Southern Pacific Railroad, has recently published some interesting particulars concerning the electrical lighting of signals at Oakland Station, California. For this purpose incandescent lamps are used. The signals were first lighted electrically on May 30th, 1887, eight lamps connected in series being employed, and since then additions have gradually been made. In normal working the lamps require 1·2 ampères to give 16 candles, but in the present case a current of only about ·8 ampère is employed, which greatly increases the life of the lamps, whilst still giving a sufficiently powerful light for the signals. Some of the lamps have already been lighted for 2,600 hours, and it is thought that they will last another year. The first cost of the plant is stated to have been low, and there is great economy in the working expenses. The light given is also more satisfactory than was that of the old oil lamps, as the face of the lens is not blackened by soot or smoke, and the light cannot be blown out.

Deafness Caused by the Electric Light.—A curious phenomenon was recently related by M. D'Arsonval before the French Academy of Medicine. After gazing for a few seconds on an arc light of intense brilliancy, he suddenly became deaf, and remained so for nearly an hour and a half. Surprised and somewhat alarmed in the first instance, but reassured by the disappearance of the symptoms, he repeated the experiment, with the same result. When only one eye was exposed to the light, no very marked effect was produced.—*Medical Press and Circular.*

Lectures.—The first of a course of public lectures in connection with the Torquay Ladies' College, recently opened, was delivered by Mr. T. Viccars, F.G.S., on "The Wonders of Electricity." The lecturer, dwelling mainly on the subjects of earlier discovery in electrical science, remarked that, if two hundred years ago anyone had suggested that lightning had anything to do with forces over which men could have any control, he would have been laughed at as a lunatic. But to-day, by precisely the same force, under the control of man's mind, the whole trade and incident of the world were focussed in the morning newspapers. Next to moral forces, electricity was probably the most potent aid to civilisation yet discovered, doing much to make the human race one family, with one interest, and inspired by kindred feelings.

Electric Locomotion Underground.—All who travel habitually by the Metropolitan Railway must wish that something could be done to improve the atmosphere in the tunnels and stations on that line. Extensive improvements are in progress for the complete ventilation of Baker Street station, but it would be satisfactory to hear that the directors had found some practicable plan of employing electrical power for their engines in place of coal. When the crowded traffic of the metropolitan railways is carried on in an atmosphere pure from the fumes of coal, and renewed by proper ventilation, many who now are compelled for health's sake to travel by public conveyances overground, will be glad to employ the more expeditious underground route.—*British Medical Journal.*

Incandescent Lamp Fittings.—Messrs. G. Binswanger and Co. have made arrangements with the European agent of the Edison factory in America for the supply of the well-known Edison sockets, cut-outs, and all other fittings. They have been induced to undertake the sale of these fittings because the want of uniformity in electrical fittings has been keenly felt by contractors for electric lighting. No doubt the English market has adopted separate and independent lines on this question all along, but whether it has been a success or not is open to doubt; the fact is apparent that we are having lamps with all sorts of fittings made, creating the utmost confusion and interfering with the home and shipping trade; whereas in almost all other parts of the globe the Edison fittings are universally adopted, and may eventually find their way into the English market. The desirability of securing interchangeable parts is a very important one, and many contractors have already given their approval of Messrs. Binswanger & Co.'s enterprise, intimating their intention of adopting the Edison fittings wherever practicable.

Personal Experience of a Shock.—Mr, T. D. Bottome relates in the *Electrical World* a personal experience of a shock. He says:—"On touching two terminals to close a circuit on some experimental apparatus, I thought, of course, I had grasped the insulation, but the bare end of a flexible wire managed to touch my right-hand fingers while I held the binding screw in the other hand. I was instantly thrown down and held perfectly rigid, unable to speak, it seemed to me for two or three minutes, but probably 20 to 30 seconds would be nearer the actual truth. I felt unconsciousness coming on, when suddenly I became loosened and I lay perfectly limp a moment or so. I got up, but was scarcely able to walk, the pains being greatest in the hips. However, I got a voltmeter and found 140 volts on the circuit, and the alternations or intermittences were 150 per second, while I found my resistance, under the same conditions, to be 4,500 ohms. The wire that slipped out of my hand left a burn on my forefinger in the shape of an elliptical hole about $\frac{5}{32}$ inch deep, and scarred the flesh about the hole at a radius of $\frac{1}{4}$ inch. During the contact I felt difficulty in breathing, but five minutes afterwards my skin was all aglow as if a bath brush and Turkish towel had been used vigorously, while the respiration became full and a trifle quickened. Two days afterwards I was all right, except a little soreness all over.

Electric Omnibuses.—The Sultan is not to have a monopoly of electrical road conveyance, says the *Financial News*. Some day soon we may have electric omnibuses plying in the streets of London; indeed, an experimental 'bus may occasionally be seen making a journey in the evening in some of the West End streets. This vehicle is the invention of Mr. Radcliffe Ward, who has been connected with several electric companies. The electric 'bus, to carry 12 persons and the engineer, costs about 20 per cent. more than an ordinary horse omnibus, but the expense of working and maintenance is said to be 50 per cent. less.

Quebec Copper.—At last a practical effort is to be made, says the *Financial News*, to develop the copper properties of Quebec, which for some years past have engaged the attention of mining authorities in that country, but, during the depression in the copper market, languished for lack of capital and systematic work. Of the value of some of the deposits there is no longer any doubt, and the company which has been formed to take over and work the Excelsior Mines has demonstrated their capacity by sending a shipment of 44 tons direct to England. Messrs. Vivian and Sons, of Swansea, having assayed various parcels of the ore, which showed 60 per cent of metallic copper, have entered into a contract to take the future output up to 100 tons per day.

Rendering Iron or Steel Incorrodible.—The following method for burnishing iron and steel by means of the electric current, was communicated by A. de Meritens at a meeting of the International Society of Electricians in Paris. The layer of oxide on the surface of the metal is obtained by placing the same as anode in a bath of common or distilled water. The sides of the vessel holding the liquid, or a piece of iron, copper or carbon, are used as cathode. The temperature of the water is kept at 160° to 170° F. The electromotive force must be just strong enough to decompose the water, as a current which is too strong gives a dusty layer which is not permanent. Under the action of the oxygen liberating at the anode, a layer of black oxide forms on the metal. This layer can be easily polished, steel giving the best results, while on cast and rod iron a more dusty layer is obtained, though the use of distilled water makes the polish permanent.

Gas Companies and the Electric Light.—According to a table prepared by the *Progressive Age*, there are 153 gas companies in the United States and Canada which operate electric light plants. The number of lamps maintained is about 13,000. The paper adds:—"This is certainly a most gratifying as well as remarkable showing, and now that the ball has commenced to roll it will not be long ere double this result will be apparent. The *Progressive Age* congratulates the gas fraternity on the liberal policy which has made this attainment possible, and the different electric lighting systems which enjoy their confidence, that they have found this new and profitable field for the employment of their talents and business energy. Finally, we find ample reason to cause us to feel gratified in the knowledge that we assumed the brunt of the battle, smoothed the way, and led the forces on both sides which are now enjoying the fruits of victory. It pays to be progressive in this age."

Brush Arc Lamps.—The Brush Electric Illuminating Company of New York has recently ordered 230 2,000-C.P. Brush arc lamps for the purpose of increasing its plant. This company is now operating between 2,500 and 3,000 arc lights.

Sprague Motors.—The Sprague Company seems to have its hands full with orders for electric motors. A recent issue of the *Western Electrician* contains accounts of quite a number of applications of the Sprague motor. A contract had been secured to supply an electric motor and gearing to the transfer-table of the Pennsylvania railroad at Altoona. The company recently installed a similar transfer-table at Aurora, Ill. A 7½ horse-power motor has been supplied to the large tobacco warehouse of Ferguson, Herndon & Co., Louisville, Ky. Work on the machinery for the electrical equipment of the West End Street railway at Boston is being pushed forward as rapidly as possible. The Sprague Company has just equipped the Hartford and Wethersfield Horse Railway with a new electric car. The Davenport Central Railway Company has accepted an electrical equipment for its road, and has expressed great satisfaction with the results so far obtained. In one week three contracts were closed for the equipment of street railways in Erie, Pa.; Reading, Pa.; and Asheville, N.C.

NEW COMPANY REGISTERED.

Automatic Electric Supply Company, Limited.—Capital: £25,000 in £1 shares. Object: To manufacture and deal in automatic delivery boxes, electrical or otherwise, machinery, appliances, &c. Signatories (with 1 share each): W. G. Hannay, 18, Duke Street, W.; G. E. Way, 18, Gascony Avenue, N.W.; H. Levites, 13, Hansy Street, W.; J. Golding, 162, Major Road, Stratford; S. J. P. Allen, 49, Endymion Road, Finsbury Park; A. Serraillier, 29, Meek Street, West Brompton; E. D. Sale, 1, Nelson Street, Greenwich. Registered 22nd inst., without articles of association, by W. G. Hannay, 28, Duke Street, W.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Ashworth Brothers and Company, Limited (Electricians).—The statutory return of this company, made up to the 1st inst., was filed on the 12th inst. The nominal capital is £10,000 in £10 shares. 159 shares have been allotted, and the full amount has been called and paid thereon. Registered office, Franklin Street, Rochdale Road, Manchester.

CITY NOTES, REPORTS, MEETINGS, &c.

The Brazilian Submarine Telegraph Company, Limited.

THE report of the directors for the half-year ended 30th June, states that the revenue for this period amounted to £109,548 11s. 9d., and the working expenses to £21,385 9s. After providing £12,880 for debenture interest and sinking funds, and £1,660 3s. 8d. for income tax, there remains a balance of £73,622 19s. 1d.; to this is added £12,916 4s. 6d. brought forward from 31st December last, making a total of £86,539 3s. 7d. A quarterly interim dividend amounting to £19,500 has been paid, and £30,000 transferred to the reserve fund, leaving a balance of £37,039 3s. 7d.

The directors now recommend the declaration of a final dividend of 3s. per share, making, with the interim dividends, a total dividend of 6 per cent. for the year, and also the payment of a bonus of 2s. per share, both free of income tax, which together will amount to £32,500, being a distribution in the aggregate of 7 per cent. for the year ended 30th June, 1888, leaving a balance of £4,539 3s. 7d. to be carried forward.

On the 31st July last, the sum of £13,900 was transferred to pay off the 139 bonds of the 1884 issue, drawn for redemption in April last. This repayment reduces the debenture debt to £174,000.

On the 4th August last the cable between Lisbon and Madeira laid in 1874 was interrupted near Madeira. The Telegraph Construction and Maintenance Company's steamship *Britannia* was without delay despatched to make the necessary repair, which was accomplished after laying four knots of new cable, when the electrical condition of the cable was found to be perfect. During this interruption the entire traffic was satisfactorily carried by the duplicate cable.

All the company's cables are in good working order except the one first laid between Pernambuco and St. Vincent, in which a slight fault has developed near the coast of Brazil, this, however, does not in any way interfere with the due transit of traffic. The directors have made arrangements for the removal of the fault at an early date.

Maxim-Weston Electric Company, Limited.

AN extraordinary general meeting of this company was held on October 19th, at the Cannon Street Hotel, Mr. John Marks (chairman) presiding. Mr. Samuel James Boyce, the Secretary, read the notice convening the meeting.

The following special resolution passed on the 3rd instant:—

"That the capital of the company be reduced from £125,000, divided into 500,000 shares of 5s. each, to £62,500, divided into 500,000 shares of 2s. 6d. each, and that such reduction be effected by cancelling capital which has been lost or is unrepresented by available assets to the extent of 2s. 6d. per share upon each of the 312,000 shares which have been issued and are now outstanding, and by reducing the nominal amount of all the shares in the company's capital from 5s. to 2s. 6d. per share," was unanimously confirmed, and Mr. Newton moved, Mr. H. R. Jones seconded, and Mr. W. H. White supported the following resolution, which was also passed unanimously:—

"That this meeting hereby requests and authorises the directors to issue a circular to the shareholders embodying the remarks of the chairman, and accompanied by a form of application for shares, and that the shareholders be urged to apply for shares within a week of the issue of the circular, and that the directors are hereby authorised to go to allotment upon applications being received for not less than 80,000 shares."

A vote of thanks to the chairman terminated the proceedings.

Western and Brazilian Telegraph Company, Limited.

THE half-yearly general meeting of this company was held yesterday afternoon at Winchester House, under the presidency of Mr. William Andrews.

Mr. Cunningham, the secretary, having read the notice convening the meeting, the report, published in our last issue, was taken as read.

The Chairman said it was his pleasing duty on this occasion, as it was on the last, to congratulate the shareholders upon the continued increase of the revenue. The gross receipts for the half-year to June 30th, amounted to £86,874, compared with £81,419 in the corresponding period of last year, an increase of £5,454, which was very satisfactory. That satisfactory increase was, they would be glad to hear, still continuing, and continuing in an augmented ratio. Down to the present time in the current half-year there was an increase, compared with the corresponding period of last year, of something like £25,000. Of course that increase might be affected during the two and a half months yet to run of the half-year, but they had no reason to anticipate that it would be very much varied. Whilst the revenue had increased, there had been a decrease in the expenditure. But it must be understood that that fact was owing to a particular circumstance with respect to renewals of cables; everybody knew that they could not conduct a larger business with smaller expense. They had paid during the half-year £13,500 for debenture interest, an item of £7,500 to reserve account, and £6,000 had been put to debenture redemption. The directors were able to recommend a dividend at the rate of 4 per cent. for the half-year, as against 2½ per cent. paid in the corresponding half-year. The accounts of the Platino-Brazilian Company had not been included in the figures he had given, for the reason that they had not yet been received. Efforts were being made to facilitate the presentation of those accounts, and he hoped in future to be able to place before the shareholders at each meeting an exact statement of their financial position. He concluded by moving the adoption of the report.

Mr. H. Weaver seconded, and, after a short discussion on matters of detail, the motion was carried, this terminating the proceedings.

The Edison and Swan United Electric Light Company, Limited.

THE fifth annual report of the directors states that the sale of lamps has progressed in a satisfactory manner during the year. [The profit and loss account shows "by sale of lamps, fittings, &c., and charges for work done, £88,110 18s. 7d."] The volume of the company's business has increased, and has resulted in a credit balance of £25,123 9s. 7d.

The directors have, after consultation with their legal advisers, lodged an appeal against Mr. Justice Kay's decision on the Edison patent. The appeal will probably be heard before Christmas.

The possession of the Cheesbrough patent gives the company a decided advantage over other makers of incandescent lamps; and as this patent has been pronounced valid by two Courts of First Instance, as well as, in one case, by the Court of Appeal, the directors hope that the company may not be put to any further necessity to defend their rights as to this valuable patent.

The Anglo-American Brush Company have brought two actions against the company—the one in connection with electrical distribution, and the other alleging that we infringe one of their patents, in a matter of detail, in the manufacture of our lamps. The former is a matter of small concern to the company, and in the latter we are advised that we have a complete answer to the alleged infringement. Much as the directors regret these legal proceedings, they feel that they have no choice but to defend the company's rights.

The Eastern Telegraph Company, Limited.—The directors announce the payment by interest warrants, on November 1st proximo, of interest for the half-year ending October 31st, on their Four per Cent. Mortgage Debenture Stock. The books will be closed from October 27th to November 1st, both days inclusive.

The West India and Panama Telegraph Company, Limited.—At the approaching half-yearly meeting, the directors will recommend a dividend of 12s. per share on account of arrears on the first preference capital, placing £2,000 to the reserve fund, and carrying over £1,255.

The Indo-European Telegraph Company, Limited.—The directors have declared an interim dividend at the rate of 5 per cent. per annum for the six months ended June last, payable on the 1st prox.

TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending October 19th, 1888, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £4,292.

AMERICAN NOTES.

By DAS TELEPHON.

YOUR readers have learned from my "Notes" that the Government of the United States had brought a suit in Massachusetts against the American Bell Telephone Company, owner of the famous Bell patents, to cancel said patents on the ground that they were obtained by fraud and perjury. The Bell Company entered a demurrer to that suit, alleging that in the absence of any specific statute the United States had no power to maintain a bill in equity to cancel a patent for an invention. Counsel for that company maintained that, even if the patent had been obtained by fraud and perjury, there was no power in the Courts to annul the patent. The case was appealed from the Federal Court in Massachusetts to the Supreme Court of the United States, and last April, on a motion of the United States Solicitor-General, the Supreme Court advanced the case on the docket, and set it down for a hearing on second day of October term, and the case was called by the newly-appointed Chief Justice, the Hon. Mellville Fuller. It is to be hoped that this telephone case will not be as fatal to him as it was to his predecessor, the eminent jurist, Chief Justice Waite, and to the late Sir George Jessel, Master of the Rolls. The case for the Government was opened by Hon. Allen G. Thurman, who for many years was considered as the Nestor of the United States Senate, at present democratic candidate for the Vice-Presidency of the United States.

Mr. Thurman, in opening the case, said he would not detain the Court very long, for in his opinion the essential elements of the case were *res adjudicata*. The bill, he said, charged that Bell had procured his patents by fraud and perjury; that Bell was not the original inventor of the telephone, but by false swearing had imposed upon the officials of the Patent Office. The fruits of that deception and perjury had been enormous; that the people of the United States, who should have the use and benefit of the telephone free from any tax for license, had been blackmailed to an enormous extent, and the people were robbed by the Bell Company of more than $10,000 a day. He concluded by saying that it was a monstrous proposition that the Government of the United States could not come to the Court to ask that its seal be torn from a document which had been obtained by fraud and perjury. Mr. Storrow, for the Bell Company, declared that the Government of the United States had not the power to maintain such a suit, in the absence of any statute conferring such power, that the fraud alleged, if any fraud had been committed, could not avail the Government in bringing the suit; that there was no remedy for the fraud.

The legal fraternity in England will no doubt be greatly shocked to hear that any lawyer of standing should set up the defence that there is no remedy against a fraud perpetrated against the Government.

I now, after hearing the arguments on both sides, which occupied eight hours, only repeat the opinion I expressed in my "Notes" in the REVIEW of April 27th, 1888, as follow: "I am well convinced that the Court will decide that the United States Government has a right to institute such a suit, although there is no express statute conferring such a right; and I am equally confident that should the case be tried to annul the patent for fraud and perjury, the Government will not be able to *prove* the fraud or perjury, although both may have been used to obtain the patents."

On 9th inst. a patent was issued to Elias E. Ries, of Baltimore, for a new method of removing ice and moisture from railway tracks, electric conductors, &c., by means of electricity. It is claimed that by this electrical method, ice and moisture can be rapidly, effectively and economically removed from the surface of a railway track in advance of an approaching train, preventing the slipping of the driving wheels of the locomotive.

A company called "The Metropolitan Phonograph Company" is booming an instrument called "the graphophone-phonograph." Below is a description of the instrument published by the company, which claims that "this little instrument will create a big sensation, if not a complete revolution in business and social circles." The company rely greatly upon the name of Bell to boom this, as one Chichester A. Bell, a brother of Bell of telephone notoriety, is one of the inventors of this wonderful ! ! ! instrument.

I am inclined to think that this invention has been *borrowed* from that beautiful creation of M. Emile Berliner, an account of which your excellent REVIEW has presented to its numerous readers.

"The graphophone-phonograph consists of a wax cylinder about one inch in diameter and six inches long, hollow and weiging about three ounces, which is rapidly revolved by a very simple apparatus, closely resembling a wood-turner's lathe, operated either by a pedal or by an electric motor, if preferred. Resting on the waxen cylinder is a disc of steel, in which is a diaphragm of mica, having in its centre a steel point; to the disc is attached a rubber tube with a mouthpiece like that used for an ordinary speaking-trumpet. Sounds of any description thrown into the mouthpiece are recorded by the steel point upon the cylinder, which when removed looks as though it had been scratched in parallel lines by the point of a fine cambric needle. When the end of the cylinder is held to the eye and examined through a magnifying glass, however, it presents very much the appearance of a circular saw, except that the teeth are not pointed and are irregular in depth, the irregularity being caused by the difference in the volume of the sounds uttered through the speaking-tube.

"By an extremely simple process, another rubber pipe, with a tube at one end and two ear-tubes at the other, is then attached and the ear-tubes placed in the ears. Every sound, no matter how insignificant, is clearly and faithfully repeated in a perfectly distinct tone, having all the qualities and inflections of the sounds originally thrown into the mouthpiece. The entire apparatus is placed upon a stand precisely like that of an ordinary sewing machine."

By invitation of the Hon. Secretary of the Navy, I was present at a crucial trial of an electric torpedo, an invention of two Americans, Geo. E. Haight and W. H. Wood, an account of which I shall send you next week.

DRIVING-BELTS.

THE Leviathan belt, which was patented by Hebblethwaite Bros., of Huddersfield, and is solely manufactured by them, has been very severely tested on all classes of machinery during the last five years, and very considerably in electric lighting with most satisfactory results on many installations put in by Mr. Wilson Hartnell, of Leeds, Messrs. Crompton, the Gülcher Company, the Thomson-Houston people, the Schmidt-Douglas Electric Light Company, and many others. A 16-inch belt was recently adopted by Messrs. Hollindrake and Clegg, of Halifax, for driving one of the largest dynamos in Yorkshire, the installation consisting of 52 arc lamps and 400 incandescent, but both dynamo and belt are capable of doing considerably more work. As it has not been specially noticed in our columns before, it gives us pleasure to now explain the principle of the belt.

The Leviathan belt is a combination of a woven belt with a leather belt, secured together by wire sewing and copper rivets. The leather runs to the face of the pulley, and forms a cushion for grip, and protects the woven part from wear. The leather does not add to the strength; practically, there is, and can be no strain on it. It is the woven part that bears the strain, and this, according to Messrs. D. Kirkaldy and Son's test, is more than three times stronger than leather. Another

very great advantage this belt has is that it is uncommonly pliable, and when put on at fairly tight tension, it does not stretch. There being no tension on the leather, it remains soft, and hugs the pulley very closely, consequently there is no slip. The belt being mostly woven, it is of very equal weight, and there is of necessity very even and steady running—a most important point in electric lighting, and a most desirable thing for any other kind of machinery.

Messrs. Hebblethwaite Bros. apply this principle to old belts that have run for a great number of years, and become unequal to the amount of power required from them, and when thus converted into Leviathan belts, the power of the belt is increased very considerably. In this way they have treated belts from 4 inches to 40 inches wide.

We have recently had submitted to us a sample of a Leviathan rope, patented by Messrs Hebblethwaite Brothers, made upon somewhat similar lines to their Leviathan belt. It is made of two or more plies of woven belting, woven to the width required, with a narrow strip of leather on the top and bottom; these are firmly secured together by strong rivets. These ropes are made both square and ∇-shape, according to the groove of the pulley in which they are required to run. The great advantage claimed for these is that they stretch scarcely at all, and as they wear away the strength is merely reduced by the amount worn off, whereas in the ordinary round twisted rope, when the surface is worn off it is simply composed of short lengths of string, held together by their own cohesion. The changes of atmospheric temperature always has a varying effect upon a twisted rope, which is one day as tight as a bowstring, and another day very slack. This difficulty is entirely overcome in the Leviathan rope, which is considerably protected from the varying effect of atmospheric changes by the leather, and also the solution which the woven part passes through previous to being put together. One of the best features in this patent rope is that it will run "crossed." It is often required that one shaft shall revolve in the opposite direction to another, and this has to be done either by a cross belt or cogwheels, otherwise all the belts driven by the second shaft must run crossed instead of open. Both square and ∇-shaped ropes have been in use for a long time, made of strips of leather; but the makers of the Leviathan rope claim an advantage over them that they can transmit a far greater power by reason of the greater tensile strength, and the firmer grip they get of the pulley.

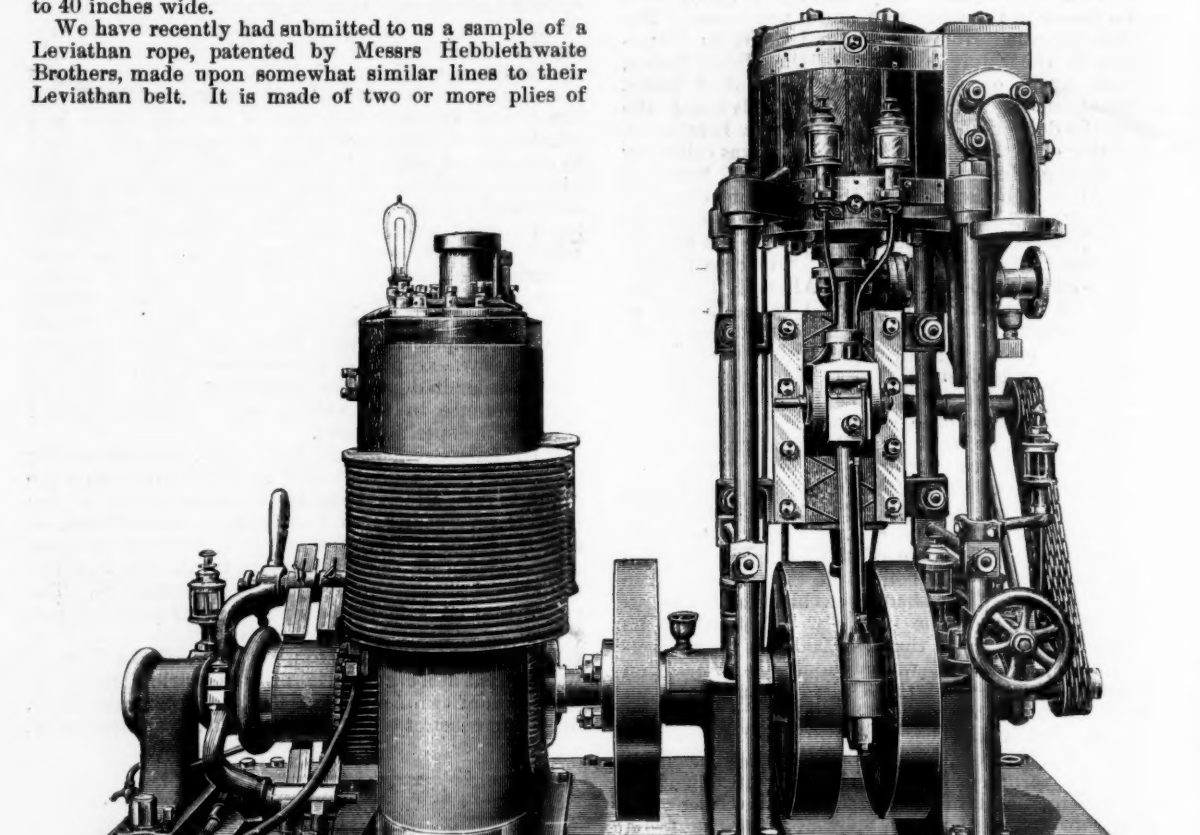


FIG. 1.—SHIP LIGHTING IN THE SUEZ CANAL.

SHIP LIGHTING IN THE SUEZ CANAL.

MESSRS. CHARLESWORTH & CO., electrical engineers, Oldham, have recently made an improved patent search light apparatus, and have sent it to the Suez Canal for use on board steamers passing through at night.

The lights required for this purpose are a search light hung in a cage over the ship's bow, for use when under weigh, and an arc lamp hung in the rigging for use when mooring at the stations.

The current is generated by an engine and dynamo taken on board with the lamps, steam being supplied from the ship's boilers.

As made by Messrs. Charlesworth, the apparatus is shown in fig. 1. The engine is of the open frame

type, this form having been decided upon in preference to any rotary or closed-in engine. The cylinder is 7 inches diameter, stroke 6½ inches, and speed 425 revolutions per minute. It is usual in passing through

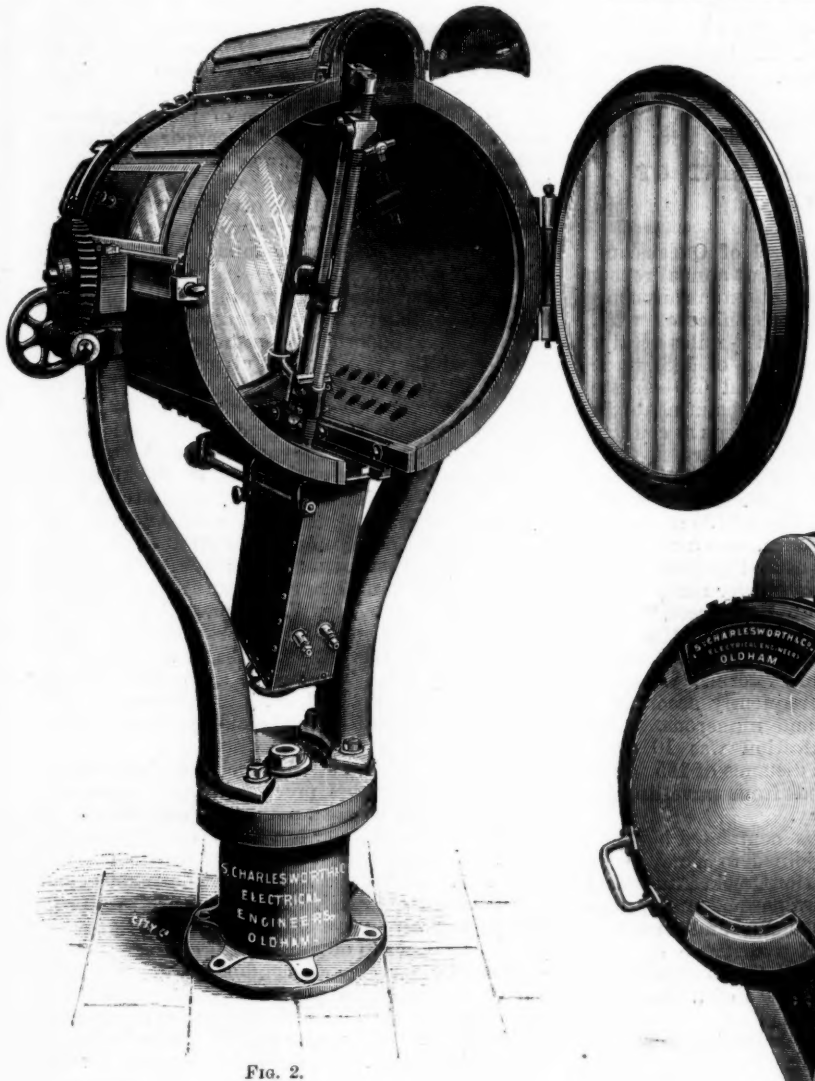


FIG. 2.

the Suez Canal, on account of the slow speed at which the vessels proceed, to allow the pressure in the boiler to fall considerably below the normal, and on this account the engine has been constructed to work at the low pressure of 40 lbs. per square inch. On some vessels, however, this custom is not followed, pressures as high as 120 lbs. being carried occasionally. A throttle valve governor does not work efficiently as a reducing valve through such wide limits, and so a hand expansion gear is fitted capable of varying the cut-off from one-quarter to five-eights stroke. By this means the engineer can set the cut-off to suit the pressure, leaving a reasonable margin for the governor to deal with. In order to reduce wear on the valve gear, a piston valve is used. The crank shaft is of Whitworth steel and has cast iron balance discs, shrunk on the crank webs.

The dynamo, which is one of Messrs. Charlesworth's No. 5, is carried on the engine bedplate, the armature shaft being coupled to the engine shaft by means of a conical interchangeable coupling. It is compound wound and gives 65 volts and 55 ampères, at 425 revolutions per minute.

The resistances are as follows:—Armature, ·151 ohm; shunt, 39·87 ohms; series coils, ·037 ohm. The machine is made rather large for its work, in order to allow for the extra heating to be expected in the climate where it has to work. In order to protect the engine and dynamo from injury when being lifted on and off the steamers, they are enclosed in a strong steel box, not shown on the engraving, the sides of which can be removed when working. A ring bolt is provided on top for lifting, and rollers on the bottom. The engine has no tendency to walk about when working, so that there is no necessity to bolt it down, a few wedges only being required under the bedplate to take up the round of the deck.

The projector, which is one of Messrs. Charlesworth's Suez Canal type, is shown in figs. 2 and 3. It is of very strong construction, the barrel being of rolled cast steel, with brass rings and longitudinal stay bars.

It is fitted with the best quality Chance mirror and dispersing lens, and has the usual horizontal and vertical movements for directing the beam of light. In order to place the lights under

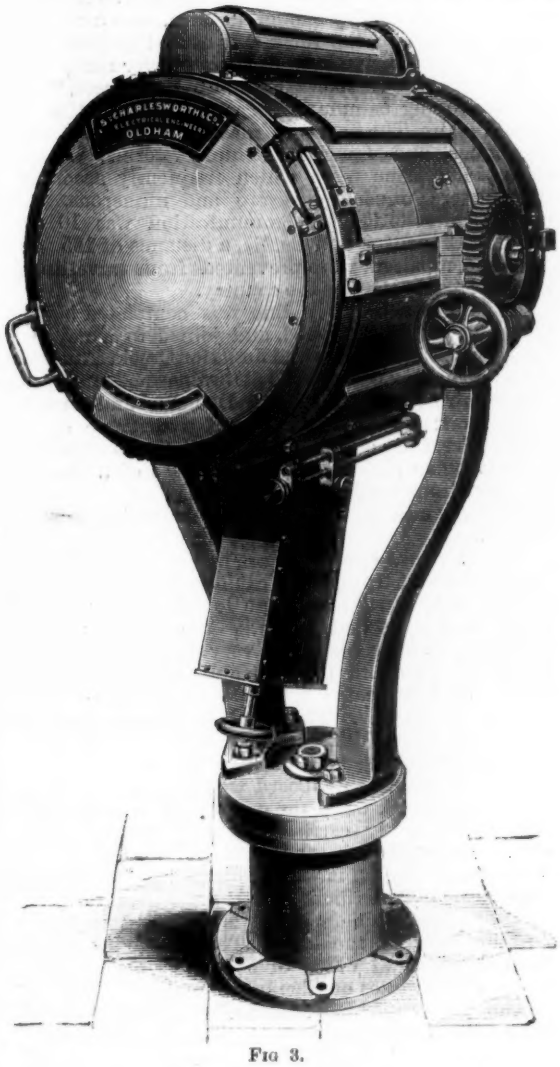


FIG 3.

the direct control of the pilot, a switch similar in appearance to an engine-room telegraph is provided, to be fixed on the bridge. Flexible armoured cables are provided for making the connec-

tions, and the necessary instruments and cut-outs are in the same box as the engine and dynamo. The engine, projector, and general arrangement are chiefly the design of Mr. Claude W. Hill, who was engaged for some time on electric light work on the Suez Canal.

The apparatus was passed by the Suez Canal Company at the first trial, and Messrs. Charlesworth have received orders for several more sets.

THE TELEGRAPH DEPARTMENT OF QUEENSLAND.

THE report of the Postmaster-General of Queensland for the year 1887 states that since the last annual report (June 27th, 1887) the total mileage of extensions completed is 683¼ miles of line and 1,486½ miles of wire, making 9,037 miles of line and 16,447¼ miles of wire open for public business. At the close of 1887 there were 293 stations in daily operation and 620 officers employed, including those holding appointments in other departments, but exclusive of assistants at country stations (officers' wives) and construction parties.

The interruptions since last report have been many, but in the majority of cases unavoidable. The luxuriant growth of grass produced by the favourable season, as soon as it became dry enough to burn, was a source of much damage to the lines and caused great delay to business, as extensive bush fires swept over many of the lines, burning the poles and also large trees, which fell, destroying communication and necessitating continual repairs. The fires were most prevalent in October, November, and January. Thunderstorms, with the gales of hurricane force which frequently accompany them, were unusually severe and numerous. The longest interruption to communication was 10 days, between Cloncurry and Boulia, a distance of 165 miles. The line repairers were prevented from travelling by the impassable state of the country.

On March 28th last a line was completed between Clermont and Ravenswood, and joined to a new wire between the latter place and Junction Creek. Automatic repeaters having been placed at Ravenswood and Springsure—Cairns, Heberton, Port Douglas, and Junction Creek work direct with Brisbane, a distance of over 1,300 miles, thus considerably facilitating business, and also giving an alternative route in case of a break on the coast lines north.

The expenditure for maintenance and repairs was £7,348.

The telephone exchanges are in good working order. The Felten and Guilleaume cable mentioned in the last report has been stretched, one length towards Petrie's Bight and a second towards the railway station, Brisbane. This cable works very well, and so far fully bears out its claim to good anti-induction qualities. There has been some falling off of subscribers at the country exchanges. The numbers connected are :—In Brisbane, 400; Maryborough, 49; Bundaberg, 30; Rockhampton, 34; and Townsville, 19. It is hoped that a multiplex switchboard will be fitted in Brisbane in a few months, when the service can be more rapidly and satisfactorily carried out. A public telephone office was opened in the metropolis on April 16th; when better known it will probably prove a great convenience to subscribers and the public. So soon as arrangements can be made it is proposed to establish further offices of the kind. The charge for using the instrument at an office of this description is 6d. for every five minutes or fraction thereof.

The Telegraph Department, we may mention, is under the superintendence of Mr. A. F. Matveieff.

Buckingham and the Electric Light.—The electric light is now employed in several business establishments in Buckingham.

ELMORE'S ELECTRO-DEPOSITED COPPER.

MESSRS. W. ELMORE have recently introduced a process for the manufacture of copper tubes, sheet, wire, &c., by which extremely satisfactory results have been obtained. The process is briefly as follows;—A revolving mandrel is nearly surrounded by ordinary unrefined Chili bars arranged upon strong supporting frames in a depositing tank of sulphate of copper, and the latter is decomposed by the electrolytic process, and is deposited in the form of pure copper on the revolving mandrel, leaving the copper in the form of a shell or pipe of any thickness required, fitting closely to the mandrel. But the essential feature in the Elmore process, and which gives it its great value, is now to be described. It is well known that copper deposited in the ordinary manner is granular or crystalline in texture, and possesses very slight cohesiveness and mechanical strength. While the copper is being deposited on the rotating mandrel, a burnisher or planisher, supported upon proper arms and levers, is allowed to press lightly upon the surface of the copper on the mandrel. The burnisher is caused to traverse from end to end of the mandrel by means of a leading screw at any required speed. The traverse is automatically reversed at each end of the mandrel, the result being that every thin film of the metal is compressed and burnished into a dense and cohesive tube of pure copper, possessing a strength and ductility which has not heretofore been attained in this metal. A series of experiments were made with these tubes by the direction of Lloyd's Committee, and their chief engineer surveyor, Mr. W. Parker, embodied the results of the investigation in a paper read by him before the meeting of the Institution of Naval Architects at Glasgow in July last. The results agree with independent tests made by Prof. B. W. Kennedy and Prof. W. C. Unwin, and show that the breaking load averages about 25 tons per square inch of section.

Electricians will naturally be more interested in the wire obtained by this process. Special machinery has been arranged so that a tube of any desired length, thickness and diameter can be cut spirally into a square wire, which can then be drawn down to the required diameter. Very great lengths of continuous conductor can thus be obtained. By the nature of the process the copper wire must *necessarily* and *unavoidably* be *pure*. In order to obtain the highest conductivity for cable and other electric conductors, the practice up to the present has been to get electro-deposited copper in the usual manner and then to exercise the greatest care in melting it into "wire bars." These latter are then drawn into wire. A very small amount of impurity introduced into the metal during the melting greatly reduces the conductivity. The advantage of the new process is, that impurities *cannot* get into the metal. The wire being drawn *directly* from the electro-burnished tube obviates entirely the necessity for melting, and thus constitutes a new departure altogether in the manufacture of *pure* copper wire.

We append extracts from reports which have been made as to the electrical and mechanical properties of the new wire. It will be observed that the 25 tons per square inch of the copper as it leaves the depositing tank is increased by the drawing to an average of 29 tons per square inch.

Messrs. Clark, Forde & Taylor's report, dated May 3rd, 1888, contains the following as to the conductivity of copper wire manufactured by Elmore's electro-burnishing process :—

> In the following report we shall speak of the conducting power of what is usually called "pure" copper as the conductivity of standard copper. This standard is founded on the experiments of Dr. Matthiessen, and represented the highest conductivity he ever obtained with the most elaborate precautions, and for many years it was believed to be the extreme limit of conducting power for copper. . . . . .
>
> Speaking generally, and before going into details, we found the conductivities of both samples of your wire to be 103, or 3 per cent. above standard copper. . . . . .
>
> We are not aware that the temperature coefficient of copper of higher conductivity than 100 has ever been published, and it is interesting to find it distinctly higher than that given by Dr.

Matthiessen for pure copper, as the probabilities were in this direction.

. . . . . .

We have been greatly interested in this wire, as its conducting power is higher than that of any sample we have hitherto tested.

The further report of the same firm, dated July 16th, 1888, says :—

According to your request we have carried out an extensive series of experiments on your copper wire, in continuation of those on which our report dated 3rd May, 1888, was based.

Our special attention having been called by yourself to a point left somewhat open in that report, viz., the relative resistances of hard drawn and annealed wires, we have carefully investigated this relation.

We received from you two large coils, the wire of the first having a diameter of 0·113 inches (about 12 B.W.G.), and the second a diameter of 0·050 inches (about 18 B.W.G.) both being extremely hard drawn.

In order, however, to satisfy ourselves that the practical limit of hardness had been reached, we drew the larger wire through 13 holes in a draw plate (the last hole being of agate) without annealing, until the diameter of the wire was reduced to ·057 inches.

Its hardness may be judged of by the fact that its breaking strain was at the rate of 29 tons per square inch, with an elongation under that strain of only ¾ per cent.

The conducting power of your *hardest* wire is still so high that, with a breaking strain of 29 tons per square inch, it has a conductivity about 2½ per cent. higher than that of *soft* annealed wire of the best quality hitherto to be procured commercially (say 98 per cent.), and therefore your annealed copper has a conducting power 4½ per cent. above that of the best commercial copper.

The following mechanical tests of the hard drawn wire have been made by us :—

The breaking strain and elongation under breaking strain were determined in the usual way.

The number of twists about its own axis which a wire 3 inches long (between jaws of torsion apparatus) could stand without breaking was also observed as under—each result being the mean of three tests.

MECHANICAL TESTS.

Diameter.	Weight per statute mile.	Breaking strain.		Elongation.	No. of twists in 3 inches.
		Observed.	Per sq. inch.		
Inches.	lbs.	lbs.	Tons.	Per cent.	
0·113	205	612	27·4	2	31
0·082	110	375	31·2	1½	42
0·057	52·8	166	28·7	¾	not taken
0·050	40·8	127	28·4	¾	47

The wire was also tested thus :—It was wrapped six times around its own circumference, as in making a "bell-hanger's joint," it was then unwrapped, wrapped again, and the operation repeated until the wire broke. The results were as follows :—

Diameter.	Specimen.	Wrapping and unwrapping the wire round its own circumference.							
Inches.		On	Off	On	Off	On	Off	On	Off
0·113	No. 1	6	6	6	6¼	6	6	...	...
	„ 2	6	6	6	6	6	6	6	...
	„ 3	6	6	6	6	6	6	6	...
0·050	No. 1	6	6	6	6	6	3	...	...
	„ 2	6	6	6	6	6	6	6	4
	„ 3	6	6	6	6	6	6	6	6

We are therefore enabled to confirm the opinion expressed in our previous report that the mechanical, as well as the electrical, properties of your copper wire are excellent.

Also in a further report, dated—

4, Great Winchester Street, E.C., 20*th July*, 1888.

Dear Sir,—In accordance with your request we send you the conductivities of three samples of your copper wire, recently tested by us, in terms of the standard for hard copper as well as in that for annealed copper.

Diameter. Inches.	Gauge (approximate) B.W.G.	Conductivity of annealed wire in terms of standard for annealed copper.	Conductivity of annealed wire in terms of standard for hard copper.
0·113	12	102·33	104·39
0·057	17	102·35	104·41
0·049	18	102·45	104·51
Mean		102·38	104·44

Yours faithfully, CLARK, FORDE & TAYLOR.

TEST FOR ELECTRICAL CONDUCTITY OF A SAMPLE OF HARD DRAWN COPPER WIRE, MARKED H.C.I.

Conductivity of sample = 102·8 of Dr. Matthiessen's standard of so-called pure copper, which is taken as 100.

I may add to this report that I have been to Mr. Elmore's mills at Cockermouth, and have spent ten days in investigating his process for depositing the electro-burnished copper tubes from which the wire is made, and thereby satisfied myself of the practical nature of the process. The fact of the wire being drawn directly from the burnished electro-deposited copper without melting ensures the maximum purity, and consequently the maximum conductivity attainable in copper, and therefore cannot fail to be highly appreciated by cable, telegraph, telephone, and other electrical engineers.

The metal being subjected to a "milling" process by the action of the burnisher over each thin film as the structure is built up, results in the production of copper of great specific gravity and tensile strength.

The process appears to me to be so simple, effective, and absolutely controllable, that all elements of uncertainty are eliminated.

CHARLES J. SIMMONS.

Dated London, *May 1st*, 1888.

The question of the cost of copper manufactured in this way is, of course, an important consideration ; and upon this point we are informed that the electro-burnished copper wire can be placed on the market in competition with that produced by existing processes.

THE PROPOSED ELECTRIC TRAMWAY IN THE NEW FOREST.

THE proposal to run an electric tramway through the New Forest, between Lyndhurst Road railway station and Lyndhurst, has excited some opposition on the part of those who wish the strict seclusion of the pretty little town to remain undisturbed, but, on the other hand, a public meeting which has just been held, and which was largely attended, passed a resolution, with only a few dissentients, in favour of Messrs. Haynes & Poole's scheme. The matter has since been considered by a vestry meeting at Eleng with equally satisfactory results.

Mr. J. W. HAYNES attended to explain amended plans which had been prepared in consequence of the objections made on a previous occasion. In answer to Col. RABBETS, he said that it was not proposed to fence in the tramway line.

Mr. WHARTON : How many cattle do you expect to kill in the course of the year ? I see there is no protection for the commoners' cows and horses.

Mr. HAYNES replied that he hoped they would not kill any, and he did not consider it likely that accidents of that kind would arise.

Mr. WHARTON intimated that he should oppose the railway.

The Rev. R. BICKERDIKE said that he should support the scheme, which he believed would be of great benefit to his parishioners and to the public generally. No doubt the tramway would be a great interference with existing interests, but they were bound in a matter of that kind to consider the greater number, especially as those who suffered any loss might be compensated.

Mr. HAYNES further stated, in reply to a question, that the promoters had had no actual experience in country places where these electrical tramways had been laid down, but they were promoting them at the present time in several rural districts.

Mr. PECK protested against a churlish refusal being given to the application. There seemed to be some question as to whether the waste by the side of the road belonged to the Highway Board or to the Crown. If the waste were not the property of the parish, then their consent would not be necessary. He suggested that the meeting should be adjourned to settle this question.

Mr. FLETCHER stated that some years ago the people of Lyndhurst opposed the railway running into the town, and had regretted it ever since. He believed they were in favour of the electric railway.

After further discussion, Mr. PECK moved a resolution approving of the scheme, provided that the line was not laid within 18 feet of the centre of the road, that electric power only was used, that proper break appliances should be provided, and that there should be no prejudice to the rights or otherwise of the Vestry over the land to be taken by the company.

Objection having been taken to some of the provisions of this resolution, it was withdrawn.

The Rev. R. BICKERDIKE moved, and Mr. ANDREWS seconded, "That the Vestry should approve of the railway as being of great advantage to the neighbourhood generally."

The word "consent" having been substituted for "approve," the motion was carried *nem. con.*, three members remaining neutral.

A Vestry meeting at Lyndhurst has decided against the construction of the railway.

LONDON CHAMBER OF COMMERCE.

ELECTRICAL AND ALLIED TRADES SECTION.

A MEETING for the purpose of completing the organisation of an Electrical and Allied Trades Section of the London Chamber of Commerce was held at Botolph House, Eastcheap, on Monday afternoon.

On the motion of Mr. H. S. PRICE, Mr. R. E. B. Crompton was appointed to the chair. Mr. KENRIC B. MURRAY, the Secretary, read the minutes of the previous meeting, and Mr. Trotter and Mr. Robinson were then appointed scrutineers of the voting papers sent in for the election of the working committee of the section.

The principal recommendations contained in the report of the organising committee were as follows:—"The committee recommend that a working or executive committee (elected annually by the general body of the trade in accordance with the bye-laws of the Chamber) be charged with the ordinary business of the section, and that in the first instance it consist of 33 members, this number to be increased to 48 at the first annual meeting of the section, if the membership then obtained should warrant a larger representation.

"It is proposed that the working committee should meet whenever occasion requires, and that meetings of the whole or part of the section, in addition to the usual annual meeting, should also be called from time to time.

"With a view to an equitable representation on the working committee of the various branches of the electrical trade, the organising committee, after preparing a classified list of members, recommend that the committee be divided into the following subsections, viz.:—Telegraph companies, 5 members; telephone companies, 3 members; electrical supply companies, 6 members; electrical manufacturers and contractors, 13 members; consulting electrical engineers, 4 members; general, two members; total, 33 members."

The CHAIRMAN said: You have before you the report of the organising committee, and, as you have no doubt all read it, I shall propose that it be taken as read, and at once call upon gentlemen present to make any remarks or ask any questions which may occur to them. The point in the report to which we particularly call your attention is the way in which we have divided up the section and the numbers by which we have thought fit to represent on the working committee each branch of the industry. That arrangement was not arrived at without considerable deliberation and heartburning, but we have fixed upon the number 33, the number allowed by the rules of the London Chamber of Commerce, until such time as we can extend it to 48, the full number allowed. We have every reason to hope that in another 12 months our numerical strength will be increased by 50 per cent., if it has not doubled; then we shall increase the representation on the committee to 48.

Major-General WEBBER said the organising committee felt very strongly that the working committee should be as representative in character as possible, that it should in the first instance consist of as large a number as possible, and that it should be elected as much as possible by the actual suffrages of the members of the section. They thought there should be no recommendations from themselves, nor any guidance as to how the members should vote. Therefore, as there were less than 200 members, they started by sending out the complete list, so that each might select the 33 for whom he wished to vote. That, he thought, was an important matter, although it might create some difficulty. He had seen some criticism in the electrical Press on their procedure in this matter, but he did not think it was very strong. It was suggested that they would have acted more discreetly if they had confined the election of representatives of each subdivision to the members of the subdivision; that was to say, that each subdivision should elect its own representatives. But he thought an examination of the list would show that they might have run into difficulties by following that plan. In the electrical world, which was very well represented by the list of members of the section, they were all pretty well known to each other, and each knew the other's merits better, perhaps, than was the case in other associations and industries. When the 33 gentlemen who would be elected to the working committee came together they would feel that the real work of the section had begun. It was very likely that they would rapidly divide themselves up into subsections, and no doubt at that moment some of them had subjects in their minds which they would wish brought before the subdivisions of the section.

Mr. R. HAMMOND, called upon by the chairman, said he had been to San Francisco and back since last meeting his electrical friends, and he was to a great extent in ignorance as to what had been done in his absence. He was glad to see that the City had at last been recognised as the centre where subjects interesting the trade or profession could be thoroughly discussed. As this movement had taken a City form, he surmised that it was intended that some profit should be extracted from it, and he should be glad to learn something of the direction in which the section was to turn its efforts.

The CHAIRMAN said for a long time past most of them who had been working in that new branch of industry, electrical engineering, had felt that united action was most desirable on many points. The isolated and independent action that many firms and companies had taken with regard to dealings with other bodies, such as local authorities, had had an exceedingly bad effect, and had not forwarded the interests of anybody. He took the case of local authorities first, because it was the most pressing one. He had at that moment in his possession a series of regulations sent to the section by the Board of Trade, and other papers from the same source, for their approval. The London local authorities were now face to face with a large number of applications of various forms, either for licenses or provisional orders under the new Act. It must be evident to everyone that that section should discuss dispassionately the way in which they should deal with those local authorities with regard to the points they were likely to put to them—whether they should pay ransom in the form of reduced cost of public lighting, whether they were to be heavily rated in the streets, whether they were to put all their wires underground and in no case overhead—all such questions could best be discussed by themselves first, and when they had arrived at a consensus of opinion they could agree to the terms they would or would not accept from the local authorities. That appeared to him to be one point of great interest. Then he would take a personal question. Some six months ago there was a strike in the works of his firm. The Society of Amalgamated Engineers decided that no piece work should be given out in the new trades. The firm stood out, and dismissed all the men belonging to the society. That was a question that affected everybody in that room who was an employer, for it might just as well have happened to any one of them, and the value of concerted action in such a matter was obvious. There were other questions as to their dealings with their men—such as questions of overtime, time paid for as overtime in other trades, but which was the regular time in electric lighting work—which it would be of great benefit for them to be agreed upon. There was one thing of which he rather fought shy, but he was convinced that it would come before them sooner or later, that was the question of prices. He dared say many members disapproved of that question being raised, and thought it was not possible for them to agree. But what was the custom in all other well-established trades? Did they find in the catalogues of steam engine makers such wide variations, such varying discounts? What an advantage it would be to them to have greater uniformity in these matters. What an advantage to know what the approximate output of a dynamo would be, what the general price of cable, and of other materials which they used in their contracts. Some of those prices were already brought together, and there was no reason why others should not be. The time of mystery with regard to electricity had gone past; they were all on their feet and in strong competition; most of them knew when an estimate was given in whether they would make a profit on it or not. Although this subject of prices might not come up for discussion at a very early stage, he thought it must eventually come, and it was only reasonable that electrical contractors and manufacturers would fix upon some standard lists and adhere to them as closely as they could, as they saw manufacturers of steam engines and gas engines doing at that moment. Then there were many questions which concerned the public; and in this connection he was glad to see in the list of members a number of names under the heading "general." It was not usual perhaps to include in such a section the names of consumers, but here there were distinct advantages. What they were trying to do was to encourage and stimulate their trade, and in order to do that they wanted to take into their confidence those who would become purchasers of their goods. They could not but derive great benefit from the advice of such gentlemen as Mr. Alexander Gordon, who was a very large consumer of electricity, upon such points as whether it was better from the consumer's point of view to have the current from the central station or to manufacture for himself, for what size installation it was best to put up a private plant, and so on. Those were all questions which could be discussed by that section, but which could not well be discussed at meetings devoted more particularly to scientific subjects. He had gone round the points which had struck him at the moment most forcibly, and no doubt there were others of which he had not spoken. With regard to the classification of the list of members, and the allotment of representatives to the different divisions, that work had not been carried out without very considerable difficulty. For instance, they had only given six representatives to electrical supply companies, yet it was certain that that division would double its numbers within the next few months, and many good men whom they would gladly include on the working committee would perforce be left out. They were obliged to give to the telegraph and telephone companies, who employed more men than the rest of them put together, a large representation, and they were obliged to cut down the representation of consulting electrical engineers to far too small proportions, but being bound to the number 33, they could not well do otherwise. He thought modern electrical engineers would be likely to benefit far more from the establishment of that section than the telegraph companies, who already had an organisation, and had got all they wanted long ago, but they could not very well have allowed them a less number of representatives on the committee.

Col. R. R. JACKSON said no doubt the chairman had represented generally the views of the London Chamber of Commerce, but he must confess, having been a director of the Manchester Chamber of Commerce and connected also with an employers' association, he thought he (the chairman) had been somewhat intermixing the functions of the two. He had never known a Chamber of Commerce deal with a question of wages, with disputes between employers and employed, nor with the fixing of prices to regulate the dealings of any trade. He did not know what the custom was within the London Chamber of Commerce; he merely

called attention to the matter in order to elicit information that would enable the members to understand exactly what they were to expect from the London Chamber of Commerce. He thought the Section must be thankful to the members of the organising committee for the way in which their work had been done. He had no doubt it had been a matter of considerable difficulty to fix the proper proportion of representation to the different divisions of the electrical trades, but he thought the result must be satisfactory to all. He wished, however, to make one suggestion for what it might be worth. He thought it would be a pity if any one of the classes were entirely unrepresented on the working committee, and that provision might be made that each class should have one representative on the working committee. If any one class were entirely unrepresented there was a danger that the peculiar questions directly affecting that class might be lost sight of.

Mr. F. L. RAWSON thought Col. Jackson had somewhat misunderstood the question of the committee, or there would have been no difficulty in his mind upon that head. He presumed that the committee would not take into consideration any points affecting, say, consulting engineers, unless there was a quorum present of consulting engineers. Then the members representing one subdivison, say, again, the consulting electrical engineers, might meet to discuss their own matters without members of other divisions being present. With regard to the questions to be dealt with, the London Chamber of Commerce left it to each section to settle for itself what questions it should take up. He had jotted down a few questions which had occurred to him as suitable for discussion by that section. There was, first of all, the important question of fire rules for electric lighting. It might be said that it would be another finger in the pie, but possibly the additional finger might put the finishing stroke upon the subject. Another question of importance was the price to be charged for current where supply companies overlapped each other. That led them to the matter of arbitration. Frequently, where parties were in dispute, they would willingly submit their differences to arbitrators appointed by the London Chamber of Commerce in preference to resorting to the risks of actions in the courts. Then, it would frequently be of very great service to the whole trade if they were to combine together to resist an attack upon a single individual or body upon a question which affected them all. Another question was the representation of "small people," who in electrical matters were very hardly dealt with, not having sufficient means or sufficient energy to fight for themselves. Of course, it would be difficult to see just where to draw the line, but no doubt some satisfactory arrangement could be arrived at. Then there was the large question of Parliamentary matters. A petition or representation coming from electrical engineers backed by the London Chamber of Commerce would certainly carry far more weight than anything coming from electrical engineers alone. With regard to patent questions, there were many disputes relating to patents which could be far better dealt with by arbitration than in a court of law. He would suggest, in conclusion, that the committee should have the power, if it thought proper for any reason to go outside itself in electing a chairman or vice-chairman, keeping, however, to the members of the section.

Mr. ROGER WALLACE moved a resolution giving the working committee the power mentioned by Mr. Rawson. This was seconded by Mr. Brown-Martin, and eventually carried. Mr. Wallace, in the course of his remarks, endorsed the views expressed by Col. Jackson as to the settlement of trade disputes being outside the functions of a Chamber of Commerce. A Chamber of Commerce was not supposed to look merely to the interests of the manufacturers, but to the welfare of the whole body.

Mr. E. GARCKE said attempts in the past to establish a representative electrical body had failed almost entirely on account of the difficulty of formulating its functions, and he thought it was a very fortunate thing that they should find in the London Chamber of Commerce a constitution and set of rules under which they could come together without difficulty, and determine what questions they should discuss and what leave alone. Mr. Crompton had mentioned one or two subjects with which he certainly hoped the section would not attempt to deal. He did not think it at all unfortunate that he should differ from Mr. Crompton; on the contrary, he thought it was a great advantage that they should have opportunities of discovering wherein they differed. But he was convinced that the more important functions of the section would be of a deliberative character rather than an administrative one. In cases where it was necessary for a body or an individual to speak in the name of the entire industry, in the case of legislation, or questions with local authorities, of representation to the fire offices, this was the body through which to work. But any attempt to regulate prices, or to stifle competition, he was quite sure would end in failure. This section was not formed with the view of establishing any particular corner or ring, but to ascertain the views of individual members on matters of common interest, and to have a centre of communication by means of which the various contractors and manufacturers might be brought together for the discussion of any question which might arise. All electrical contractors were aware that specifications were frequently issued which no contractor would work to. In their individual capacity they were frequently at a loss what to do in such a case, for they felt that other firms would tender if they did not. If an opportunity were afforded of bringing the principal contractors together within a few hours when such a case arose, it would be a great advantage, and any suitable course might easily be decided upon.

Mr. RAWSON presumed the committee would have power to subdivide as much as it liked and to form another section if it seemed desirable.

The CHAIRMAN believed that was the case. He wished to explain with reference to the question of prices, that he had not expressed his views upon the matter, but had merely mentioned it as a thing which would certainly crop up. He did not think it was fair, in talking about the regulation of prices, to suggest that there was any question of stifling competition. The moment they tried to regulate prices they would endeavour to produce the same thing, and to do it in the same way. They were trying to do that now, but not perhaps in a very intelligible way. What he had been pointing to was done in every other trade, and was not done in their own simply because it was a new trade. It might possibly be outside the functions of that section to deal with labour questions; but they were not like other trades, where there were associations of employers. This section would give the requisite opportunity to those of them who might wish to form such an association. They might have representatives of the workmen amongst them, and with the powers of reference and arbitration which the London Chamber of Commerce afforded them, they might come to an amicable settlement of disputes much more speedily than if the two parties kept at arm's length for months, the employers talking amongst themselves on one side, and the employés on the other. It might seem almost a Utopian idea at present to talk arbitration upon patent questions, but it was not quite so Utopian as it might at first appear. The Chamber had for some time past directed special attention to the facilities it afforded for arranging for arbitration, and the point was one well worth considering. It was perfectly true that there were many who could not afford to go to law on questions respecting patents of small value, and facilities for pooling small patents and fixing a price by arbitration would be of benefit to all of them.

Mr. REEVES moved the confirmation of the report of the organising committee, which was seconded by Mr. Brown-Martin, and carried.

Major-General WEBBER, remarking that considerable time must necessarily be taken by the scrutineers in going through the voting lists, moved the adjournment of the meeting, and that the result of the voting should be announced by post.

This was agreed to, and the meeting terminated, a vote of thanks being accorded the chairman.

RESULTS OF THE VOTING FOR WORKING COMMITTEE.

The names are placed in order of number of votes given, and those bracketed together indicate a tie.

Telegraph Companies (5).

Sir James Anderson.
Sir John Pender.
Mr. J. Herbert Tritton.
The Marquis of Tweeddale.
(Anglo-American Telegraph Company.) (Mr. C. W. Earle.) („ R. K. Gray.)

Electrical Manufacturers and Contractors (13).

Mr. R. E. Crompton.
„ Alex. Siemens.
„ Moritz Immisch.
„ E. Garcke.
Messrs. Woodhouse & Rawson.
„ Johnson & Phillips.
„ Laing, Wharton & Down.
„ Callender & Sons.
„ Drake & Gorham.
Sir Daniel Cooper.
Messrs. W. T. Goolden & Co.
Edison and Swan United Electric Light Company.
(Verity Bros.) (Mr. J. J. Courtenay.)

Telephone Companies (3).

Mr. J. Brand.
Colonel R. R. Jackson.
Oriental Telephone Company.

Electricity Supply Company (6).

Major-General Webber
The Earl of Crawford.
Mr. J. E. H. Gordon.
„ Roger Wallace.
„ Mark Parker.
„ R. S. Erskine.

Consulting Electrical Engineers (4).

Mr. W. H. Preece.
„ Gisbert Kapp.
Messrs. H. Alabaster, Gatehouse & Co.
Mr. W. H. Snell.

General (2).

Sir David Salomons.
Mr. Quintin Hogg.

NEW PATENTS—1888.

14687. "An improved portable electric lamp, applicable also for house lighting." J. LOWE, H. M. ABBOTT and G. GWILT. Dated October 12.

14691. "Improvements in telephone central station apparatus." T. N. VAIL and J. A. SEELY. Dated October 12. (*Complete.*) [Date applied for under Section 103 of the Patents, &c., Act, 1833, April 20, 1888.]

14731. "A siren actuated by electricity." F. H. NALDER, H. NALDER, C. W. S. CRAWLEY and A. SOAMES. Dated October 13.

14741. "Improvements in the application of electricity to the propulsion of tramway cars and railway trains, or of other vehicles and canal or other boats." T. PEASE. Dated October 13.

14772. "A meter or apparatus for measuring the strength of continuous or alternating electric currents." G. F. REDFERN. (Communicated by L. Brillié, France.) Dated October 13. (*Complete.*)

14789. "Improvements in applying electricity to the driving of tramway cars, railway or road carriages, barges, or other boats." T. PEASE. Dated October 15.

14829. "Improvements in portable galvanic batteries." W. J. S. BARBER-STARKEY. Dated October 16.

14843. "Improvements in electric meters." J. OULTON and J. EDMONDSON. Dated October 16.

14888. "Improvements in electric cranes." T. D. HOLLICK. Dated October 16.

14901. "Electric heat and fire detector test board." B. A. DOUGHERTY. Dated October 17.

14910. "The regulation of electrical induction coils." S. A. LOVICK. Dated October 17.

14924. "An improved incandescent electric lamp." E. BOHM. Dated October 17.

14932. "Improvements in and connected with portable electric incandescent lamps and batteries." S. W. MAQUAY. Dated October 17.

14941. "An electrical apparatus for the prevention of burglaries in dwelling houses." A. GAUGE. Dated October 17.

14963. "Improvements in electric bells and signals, and in appliances for use therewith." E. COX-WALKER and A. A. C. SWINTON. Dated October 18.

14979. "Improved electrical brake and apparatus for automatically actuating same." R. R. HUTCHINSON. Dated October 18. (*Complete.*)

14980. "Improved method of and apparatus for operating capstans, windlasses, hoists, and the like, by means of electricity." R. R. HUTCHINSON. Dated October 18. (*Complete.*)

14981. "Improved method of and apparatus for actuating printing machinery by means of an electric current, and instantaneously checking or arresting the motion thereof when required." R. R. HUTCHINSON. Dated October 18. (*Complete.*)

14982. "Improved method of and apparatus for operating turntables for railways and other purposes, by means of an electric current." R. R. HUTCHINSON. Dated October 18. (*Complete.*)

14983. "Improvements in telpher lines, or elevated suspended railways, and vehicles and locomotives therefor." R. R. HUTCHINSON. Dated October 18. (*Complete.*)

14984. "Improved method of and apparatus for rotating hydro-extractors by means of a current of electricity, and automatically checking or arresting the motion thereof when desired." R. R. HUTCHINSON. Dated October 18. (*Complete.*)

14985. "Improved method of and apparatus for utilising a current of electricity for operating pile-driving machinery, and rendering the action of same automatic. R. R. HUTCHINSON. Dated October 18. (*Complete.*)

14986. "Improved method of and apparatus for applying electricity as a motive power to cranes, sheer legs, and the like." R. R. HUTCHINSON. Dated October 18. (*Complete.*)

14987. "Improvements in fans, air propellers, and the like, and method of operating the same by means of an electric current, and apparatus therefor." R. R. HUTCHINSON. Dated October 18. (*Complete.*)

14988. "Improvements in 'mashers' and 'mixers' as employed in brewing and other processes and method of and apparatus for applying electricity as a motive power for same." R. R. HUTCHINSON. Dated October 18. (*Complete.*)

14989. "Improvements in steering apparatus for ships, and method of and apparatus for utilising electricity as a motive power for same." R. R. HUTCHINSON. Dated October 18. (*Complete.*)

15008. "An improvement in electric arc lamps." J. FYFE. Dated October 18.

CORRESPONDENCE.

Calculating the Internal Resistance of a Storage Battery.

Mr. J. D. Dallas's method of measuring the internal resistance of batteries of low resistance described in the *Electrical World*, and given on page 432 of your last issue, is not new; it was devised by me, and given on page 299 (par. 326) of the 4th edition of my "Handbook of Electrical Testing."

H. R. Kempe.

Engineer-in-Chief's Office,
General Post Office, *October 20th.*

Munro and Jamieson's Pocket Book.

Seeing that my partner and I have received the request from our publishers, Messrs. Chas. Griffin & Co., London, to collect and prepare data for the sixth edition of Munro and Jamieson's "Pocket Book of Electrical Rules and Tables," we are anxious to receive opinions from good sources regarding how we can best improve the little book and keep it abreast of the times.

The other day I received the enclosed letter. Can you, or any of your readers, give us an answer, and tell us what is the best practical solder for land lines?

Andrew Jamieson.

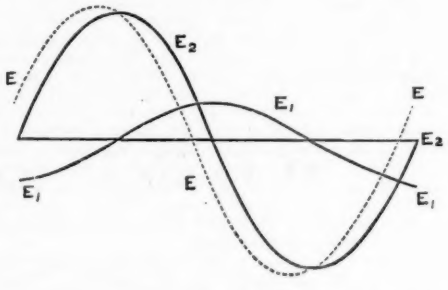
The Glasgow and West of Scotland
Technical College, *October 17th*, 1888.

Dear Sir,—Permit me to draw your attention to page 415 of your admirable "Pocket Book on Electrical Rules and Tables," where you say the best solder for telegraph line wires is composed of 8 parts bismuth, 3 lead and 5 tin, but in getting a supply of bismuth I find it costs 12s. per pound, making most expensive solder for outside works. Surely there is some mistake, as if bismuth is so costly it will preclude its use for solder, &c.

A Synthetic Study of Dynamo Machines.

It is possible that the diagrams in last week's issue may have proved to the reader somewhat perplexing. Fig. 35 is upside down, and to correctly represent the facts, the angle through which the rotating frame moves should therefore be considered as from *right* to *left*, the dotted curve of impressed E.M.F. preceding the current curve.

Owing to a mistake of the draughtsman the ordinates of E_1 and E_2 in fig. 36 were erroneously measured to give E the impressed E.M.F. As a matter of fact the dotted curve ought to be moved to the left by a distance equal to twice A, *b*, or in other words, the drawing showed E lagging behind E_2 by an angle, A, *b*, instead of preceding E_2 by the same angle. The correct diagram here



given should be compared with that previously drawn, and the latter corrected in red ink in last week's issue. The angle increases from left to right.

Some of your readers may have inferred from the text that a mistake had occurred, but, in any case, the explanation now given will make all clear. How the diagram was sent to you without detection of an error so apparent remains a profound mystery.

The Writer of the Articles.

The Blackpool Electric Tramway.

I should not have objected to Mr. Slater Lewis boasting of the better condition of the Blackpool line since he supplied insulators well made, but when he for the second time makes an unprovoked attack upon me I cannot remain silent, and therefore wish it to be publically known that Mr. Slater Lewis made the first insulators for Blackpool, to my design certainly, but, unfortunately, so badly glazed that they failed. It has often been a matter of regret to me that I accepted his assurance of efficiency and allowed them to be used.

The insulators he is now supplying are so similar to those patented by me, that it is only out of regard to the Blackpool Tramway Company that I have hitherto refrained from interfering. But I shall certainly do so if he presumes to supply them to anyone else.

The reason for the better insulation of the line is partly due to the fact that Mr. Lewis has improved in the quality of his manufacture, but also to the greater care taken by Mr. Broadbent, the managing director.

M. Holroyd Smith.

October 23rd, 1888.